Report on

Permanent Water Supply

FOR THE CITY OF MOUNT VERNON

THE Board of Water Supply herewith submits the complete report of George W. Fuller, Esq., relative to a permanent water supply for the City of Mount Vernon.

It is the desire of our board that the citizens of Mount Vernon be fully informed on this important matter, which so vitally concerns the health, prosperity and growth of our city, pending the recommendations to be made by us; so that intelligent action may be taken when the final plans are submitted to a vote of the people.

Respectfully,

THE BOARD OF WATER SUPPLY.

JOHN W. STEVENS, *President*,
DR. W. H. PURDY, *Secretary*,
BENJAMIN J. CULLEN, *Treasurer*.

REPORT OF

GEORGE W. FULLER

CONSULTING ENGINEER

170 BROADWAY

New York City, September 13, 1911.

To the Board of Water Supply,
Mount Vernon, N. Y.

Gentlemen:

In compliance with the Resolution of the Common Council, adopted on March 7, 1911, we present the following report on the question of an adequate public water supply for the City of Mount Vernon, N. Y. The scope of the investigations and advice contained in this report is detailed in the Resolution, as follows:

"1). As to the economical aspects and suitability of obtaining water from the existing sources of the New York Inter Urban Water Company, supplemented by additional storage at some suitable point east of the City.

"2). As to the economical aspects and suitability of obtaining a water supply from New York City.

"3). As to the economical aspects and the suitability of a supply of well water which may be obtained from the Hutchinson creek valley, supplemented at times by water from New York City.

"4). As to the desirability of purchasing the entire plant of the New York Inter Urban Water Company, including its sources of supply at Pelham and Mamaroneck and the existing pipe line from the latter, as well as the distribution system in Mamaroneck, Harrison, Rye, etc.

"5). As to the relative advantages and disadvantages of a municipally-owned water works system as compared with continuing the private ownership of the water works for Mount Vernon.

"6). To compare the relative advantages and disadvantages of the propositions mentioned in paragraphs 1, 2 and 3, and to advise as to the best step for the city to take in getting a suitable water supply as to quality and quantity, and with the special object of seeing which is the cheapest source of a reliable and safe supply at all seasons of the year under suitable pressure, into the piping system within the limits of the City of Mount Vernon.

"And also to prepare a design and estimates of cost for a complete new distributing system in the City of Mount Vernon to serve adequately the needs of the present time and in the early future; and to estimate the cost of laying additional pipes to reinforce the existing piping system. Also to estimate what depreciation is fairly allowable for the present piping system due to age, wear and tear, and to estimate the value of the present piping system to the city by subtracting from the estimated cost of a proposed new system both the item of depreciation on the old system, as well as the expense of additional pipes to bring it up to the service afforded by the proposed new system."

Since the above Resolution was passed and the engineering work was undertaken in co-operation with the Committee on

Water Supply of the Board of Aldermen, an Act was passed by the Legislature at Albany and approved on May 10, 1911, creating a Board of Water Supply for the City of Mount Vernon. This Board practically succeeded the Water Committee of the Board of Aldermen, although in the development of this proposition we have received the co-operation and assistance of the Mayor, the Board of Aldermen and the new Board of Water Supply.

Since this work was undertaken, the partnership agreement of Hering & Fuller has terminated and the work has been completed by Mr. Fuller and his new partners, in accordance with the notice which was sent to you by Hering & Fuller under date of June 21, 1911.

Under date of May 8, 1911, a Resolution was adopted by the Common Council, directing the engineers to prepare plans and specifications and to proceed to take bids on the construction of four wells and appurtenances on city property in the vicinity of Warwick avenue. Reference is made in this report to certain experiences in the development of these wells. Full details will be embodied in a later report.

GENERAL STATEMENT OF PROBLEM.

The chief reason for making this investigation was the shortage of water as supplied to Mount Vernon by the New York Inter Urban Water Company during the late summer and autumn of 1910. This shortage was first in evidence on or about July 19, when the water ceased to flow over the dam in the Mamaroneck river, adjoining the pumping station. Conditions became acute in September. The deficiency in supply during October and portions of September and November was great, resulting in much inconvenience and discomfort.

Beginning on or about September 20, 1910, some relief was obtained with the water furnished by the City of New York from the Croton supply through several small connections between the piping system of the City of New York and that of the water company of Mount Vernon. This supply, however, for some three months or more did not amount to more than 45 million gallons in the aggregate. The pressure was very low, especially in the higher districts. The water from the City of New York was furnished purely as a matter of accommodation and through no obligation of New York to take care of the needs of its neighbors. It was on or about December 26, 1910, when the winter rains first allowed the pumps of the Inter Urban Water Company to operate at full capacity with water regularly flowing over the dam in the Mamaroneck river. Some water was also obtainable from the Tarrytown supply.

In March, 1911, it became apparent that the winter rainfall conditions on the Croton watershed had been such that there was small or no likelihood of being able to obtain water in Mount Vernon from the City of New York. In fact, there is no like-

lihood of much, if any, water being obtained from the City of New York until the Catskill supply is delivered into Croton lake, which, it is expected, will be accomplished during the latter part of 1913.

The contract of the Inter Urban Water Company with the City of Mount Vernon expired in December, 1908. In the absence of any competition the Company has continued to supply about three million gallons of water daily to Mount Vernon, Mamaroneck, Harrison, Rye Neck and Pelham Heights. About 85 per cent. of the supply is said to be delivered to Mount Vernon. This city, with a population of about 30,000 is therefore supplied, according to these data, with water to the extent of about 85 gallons per inhabitant on an average.

The supply of the New York Inter Urban Water Company is obtained principally from the Mamaroneck river above the village of Mamaroneck, where the drainage area of the watershed is approximately 15 square miles. Only about 12 million gallons of water are stored by the diversion dam adjacent to the pumping station.

Another and older supply of this Company is at Pelhamville on Hutchinson creek, near the N. Y., N. H. & H. R. R. Here are three open sand filters, which may receive water either from Hutchinson creek or Tom Payne creek. The former at this point as a total drainage area of about 5.5 square miles, but the upper 3.4 square miles of this are utilized by the storage reservoirs of the New Rochelle Water Company.

On Tom Payne creek, in New Rochelle, there are two storage reservoirs, the drainage area of which is about 1.56 square miles, and the capacity of which is about 90 million gallons.

There is also a 16-inch pipe connection extending north from Mount Vernon to the pipe lines of the Consolidated Water Company, which derives its supply from Pocantico river.

Accompanying this report is a location map (Sheet No. 1), on which has been sketched as a matter of convenience for reference the location of the principal towns and the sources of water supply referred to in this report. Attention is here called to the fact that available resources of surface water supply in the vicinity of Mount Vernon are from streams small in drainage area and provided at present with comparatively little storage capacities in those localities from which water is now derived for Mount Vernon. Consequently a new water supply from surface sources means either considerable expense for investment in storage reservoirs, or expensive conduits to distant sources, the cost of which will be quite high, owing to the rough and rocky character of the country.

In the absence of any contract with the City of Mount Vernon, the New York Inter Urban Water Company is unable or unwilling to provide funds with which to develop necessary storage upon the Mamaroneck river or some other suitable sources of an increased supply.

The City of Mount Vernon, by virtue of its unusual trans-

portation facilities and location adjoining the northern limits of the greater city of New York, has grown rapidly in recent years. This growth has tended to aggravate the problem of its public water supply. In considering the facts surrounding this water works property and the manner in which it has become outgrown with respect to the demands made upon it, it is necessary to bear in mind the growth of the population of Mount Vernon, as follows:

TABLE 1.

Population of Mount Vernon—U. S. Census.

1880	4,586
1890	10,830
1900	21,228
1910	30,919

The proposition at hand, therefore, is an important and serious one with respect to providing for reasonable requirements both as to the present and also the future needs of the city as to water supply.

At the conclusion of this report there is given a full summary of our investigations, with recommendations in the premises. Intermediate pages are devoted to a record and discussion of the data which we have obtained from our personal inspection on the ground and also the data which we have obtained from the records supplied to us by the city officials of Mount Vernon and the officers of the New York Inter Urban Water Co.

Attached to the report is also a map (Sheet No. 2), showing the distributing pipe system as it now exists in the city of Mount Vernon; also a map (Sheet No. 3), showing a new design which we have prepared for a water distributing system of new pipes to serve the needs of the city for the present and in the early future; and maps (Sheets Nos. 4, 5 and 6), showing the location and size of water pipes owned by the New York Inter Urban Water Co. in Pelham, Harrison and Mamaroneck and Rye Neck, respectively. Sheets Nos. 2, 4, 5 and 6 have been prepared from data furnished by the New York Inter Urban Water Co. after checking the same on the ground with our own inspectors. Sheet No. 7 shows a profile for a pipe line from Byram river to Mamaroneck pumping station, according to a recent survey made by us.

HISTORICAL DESCRIPTION OF THE WATER SUPPLY OF MOUNT VERNON.

The first public water supply for the City of Mount Vernon was from driven wells, and was installed in 1884 by the Mount Vernon Water Co. In 1885 the New York & Mount Vernon Water Co. was incorporated, and their system was put in operation in July, 1886. This company was succeeded in 1891 by the New York City Suburban Water Co., and that company in turn by the New York Suburban Water Co. in 1895 through foreclosure sale. The New York Inter Urban Water Co., the present company, became the owners in 1901.

Hutchinson creek furnished the entire supply from 1886 to 1892. At that date, owing to the storage and diversion by the New Rochelle Water Co. of water from Hutchinson creek above the intake of the New York & Suburban Water Co., the latter company was forced to look for an additional supply. This supply was secured by purchasing and enlarging the Mahlstedt ice pond on Tom Payne creek in the City of New Rochelle. The water from the reservoir thus formed was conveyed over the ridge lying between the reservoir and Hutchinson creek by a 12-inch pipe siphon and a line of 16 and 18-inch pipe into the Hutchinson creek supply at the pumping station. Both of these supplies were pumped from what is known as the Pelhamville reservoir at Hutchinson creek into the city distribution system and into the standpipe located at Third and Fulton streets.

On August 1, 1894, an uncovered sand filter plant was put into operation at the Pelhamville site. This filter plant, of a design similar to the one at Lawrence, Mass., consists of about 1.25 acres of filters in three units and was used in purifying the water from both the Hutchinson and Tom Payne creeks. It is said to be the second plant of its kind in the United States.

With the growth of Mount Vernon, the supply obtained from these two sources was found to be inadequate, and in 1903 and 1904 a 16-inch pipe line was built to connect with the pumping station, filter plant, etc., at Mamaroneck river, which is at present the principal source of supply.

In 1907 the New York Inter Urban Water Co., desiring a distribution reservoir on the system to supplement the standpipe at Third and Fulton streets, bought some six or seven acres of land at a high point in Yonkers for this purpose. It is stated by the Water Company that owing to legislation passed that year by the City of Yonkers, it became impossible for them to obtain rights of way for a pipe line from this site to Mount Vernon, and they were forced to give up the project.

In 1907-08 the Water Company built a 16-inch pipe line from Mount Vernon to connect with the line from the Metz reservoir owned by the Consolidated Water Company of Suburban, N. Y. This was the last addition of any moment made to the Mount Vernon supply.

From the foregoing it is seen that the present supply is from four sources. The main supply is pumped from Mamaroneck river. Two others, from Hutchinson creek and Tom Payne creek, are pumped at Pelhamville. The fourth is an emergency gravity supply from the direction of Tarrytown. In addition to these, there are connections with the New York water supply at different places which have been used in times of emergency.

Distribution System. The distribution system, that is, the piping layout within the boundaries of Mount Vernon, and excluding the larger main lines running from the various sources of supply, consists of about 61 miles of cast-iron pipe of sizes from 4 inches to 16 inches in diameter, a steel standpipe at the

corner of Third and Fulton streets, 797 gate valves of various sizes, 633 hydrants, 4,735 meters, and 5,419 service connections. The first pipes in the system were laid in 1884, and on July 1, 1886, the piping system was 10.7 miles in length. This has been gradually added to each year from 1886 to the present date, the average age of the entire system now being about 15 years. The main supply line is a 16-inch cast-iron pipe line which brings water from both the Mamaroneck and Pelhamville supplies and extends to the standpipe.

The water supplying that portion of the city south of the N. Y., N. H. & H. R. R. is distributed by pipes connecting with the standpipe and also by direct connection with the pumping mains. There is a small proportion of 16-inch and 12-inch mains; most of the pipe, however, being 6-inch and 4-inch in diameter.

That portion of the city north of the railroad is connected to the system south of the railroad by a 10-inch pipe on Columbus avenue, an 8-inch pipe on Park avenue, a 12-inch pipe on Fourth avenue and a 6-inch pipe on Fourteenth avenue. There is also a 10-inch line on Lincoln avenue, which is connected directly to the 16-inch line from Mamaroneck above the point where that line reaches the Pelhamville plant. In addition to the above, there is a 10-inch line on Fourth avenue which connects with the 16-inch supply line from Tarrytown. The following is a table of various sizes of water pipe in the Mount Vernon distributing system:

TABLE 2.

Length of Different Sizes of Pipe in the Distribution System in Mount Vernon.

Sizes.	Length.	Per Cent. of Whole.
4-inch	52,980′	16.42
6-inch	204,421′	63.50
8-inch	17,048′	5.30
10-inch	38,121′	11.82
12-inch	2,439′	0.76
16-inch	7,090′	2.20
Totals,	322,099′	100.00

In general, the pipe system is well laid out for works of its age. The chief faults are in having too few cross connections and too many long lines of small pipe. A larger proportion of 8 and 12-inch pipe, especially in the business district, would also be preferable.

Pelhamville Plant. This plant is located on Hutchinson creek just north of the N. Y., N. H. & H. R. R. tracks, about one-half mile east of the Columbus avenue railroad station. It includes a reservoir, with a capacity of 11 million gallons, on Hutchinson creek, formed by an earth dam about 600 feet long with a 24-foot spillway at elevation 27.43. The elevation of the top of the dam is 31. On the downstream side of the dam are

three sand filter beds, having a total area of about 52,000 square feet. Just inside of the sand filter beds is a circular masonry suction well about 10 feet in diameter and 12 feet deep. On the west side of the filter is located the brick pumping station, containing one 3-million gallon compound condensing duplex Dean pump and one Worthington 4.5-million gallon compound duplex pump. The Dean pump was installed in 1886 and the Worthington pump in 1896. The pumping station also contains two 135-horsepower boilers, which are connected with a new steel stack 42 inches in diameter and 100 feet high, standing on brick foundations. There is also a masonry receiving well about 10 by 6 by 6 feet, from which the water from Tom Payne creek is discharged over a cascade to the filter beds.

The water from Hutchinson reservoir passes on to the filter beds and from them into the suction well and thence to the pumps. The water from Tom Payne creek may pass either from the cascade to the filters, or into the reservoir and thence on to the filters with the Hutchinson creek water. The pumpage at this plant is not continuous, as the supply is only used as an auxiliary to the Mamaroneck supply. As now arranged, only one of the pumps in the station can be used at a time.

Tom Payne Creek. This supply flows into a small reservoir called the Lester reservoir, having a capacity of about 5 million gallons, thence through a 36-inch pipe to a reservoir called the Mahlstedt reservoir, which has a capacity of about 85 million gallons. The Lester reservoir is entirely in excavation and the sides are paved. The Mahlstedt reservoir is about one-half in cut and one-half in embankment. It has been excavated so as to leave no shallow spots and the sides are practically all paved. The water from this reservoir, as before mentioned, flows to Pelhamville either to the reservoir or filters. The watershed of Tom Payne creek is about 1.56 square miles in extent.

Mamaroneck Supply. This supply is taken from a reservoir on the Mamaroneck river about 1.5 miles north of the N. Y., N. H. & H. R. R. at Mamaroneck. The reservoir is formed by a dam across the river some 200 feet in length and with a 90-foot spillway. The dam is a timber crib structure, stone-filled and with plank facing and apron. The crest of the spillway is at elevation 45.78. The reservoir has a capacity of approximately 12 million gallons. From the reservoir the water is taken through a 12-inch cast-iron pipe into a concrete settling basin of about 650,000 gallons capacity. This tank is 115 feet long, 65 feet wide, 12 feet deep, and uncovered. Before passing through the basin the water is treated with sulphate of alumina. From the settling tank the water passes through a 20-inch cast-iron pipe to a circular masonry suction well. By-passes are provided so that the water may be taken directly to the suction well from the settling basin or reservoir. The water is taken from the suction well by either or both of the two 3.25-million gallon Wetherill pumps and thence through the four 8-foot by 25-foot pressure filters to the 16-inch force main. The pumping station is of uncoursed

stone masonry with red Spanish tile roof. A small laboratory is maintained in the station and daily analyses of the raw water and effluent from the pressure filters are made.

Tarrytown Supply. This supply is from a distributing reservoir which is supplied by pumps taking water from Pocantico lake, and is conveyed to Mount Vernon through a 16-inch pipe line about 15 miles in length. About 23,800 feet of this line belong to the Inter Urban Water Company, the remainder being owned by the Consolidated Water Company of Suburban, N. Y. On ordinary occasions this supply is capable of delivering two million gallons a day to Mount Vernon, but at exceedingly dry times, such as last summer, the entire supply from this source is used by Tarrytown, Irving, Ardsley, and various other places above Mount Vernon, so that this source cannot be depended upon for satisfactory service during an extended drought.

New York City Supply. There are three emergency connections with New York City water supply, as follows:

One at the corner of 242d street and Carpenter avenue through a 4-inch Gem meter.

One at the corner of 243d street and Carpenter avenue through a 6-inch Gem meter.

One at Boston road, East Chester, through a 6-inch Crown meter.

PRESENT AND FUTURE WATER REQUIREMENTS OF MOUNT VERNON.

The City of Mount Vernon occupies an area of about 2,500 acres and in 1910 it had a population of 30,919 according to the U. S. Census. We have made a number of estimates as to the future growth of the city, taking into account the local conditions, present and prospective, so far as we are able so to do. Mount Vernon is essentially a high-class residential district and undoubtedly it will continue as such. Consequently the density of population will be less rather than more than that of manufacturing towns. The railroad facilities in Mount Vernon are exceptionally good and with the opening of the Boston & Westchester railroad they will be even better than at present.

It is also well to take into account the fact that the transportation facilities generally throughout the metropolitan district have recently improved and are likely to continue so to do to a considerable extent in the future.

Unless manufacturing establishments or an unusually large proportion of apartment houses for a suburban community should become established in Mount Vernon, it does not seem likely to us that the population should become more dense within the present area of city limits, than about 30 persons per acre on an average. This would give an ultimate growth to the present city of Mount Vernon equal to a total population in round numbers of 75,000 people.

We have approached the matter in another way by preparing

curves showing the rate of growth of other cities more or less similarly situated. Taking everything into account it appears fair to us to assume that in 30 years from now Mount Vernon will have in round numbers a population of from 75,000 to 80,000 people.

As to the rate of growth, that is dependent upon a number of local factors. Generally speaking it seems reasonable to assume that by 1920 the population will be in the vicinity of 45,000 people and in 1930 in the vicinity of 60,000 people.

This report is prepared with a view of providing for the requirements of Mount Vernon itself for a sufficiently long period in the future to insure a sound business aspect to the water works proposition. In the early years, if the city should buy the property of the New York Inter Urban Water Co., it would be necessary also to figure upon the population of those other communities outside of Mount Vernon which derive their water supplies from the present company. To show the extent of such use, Table 3, based upon data furnished by the Water Company, is given. It indicates the consumption of water in Mount Vernon, Mamaroneck, Rye Neck, Harrison and Pelham Heights as accurately as it is feasible for us to do from the available information.

In examining the annual summaries of these records for the past five years, it is interesting to note that the total annual water consumption has increased nearly 50 per cent., and that the apparent water consumption per capita in Mount Vernon has increased by about 38 per cent.

TABLE 3.

Summary of Annual Records Showing Total Quantity of Water Supplied by the New York Inter-Urban Water Company, with Estimated Annual Consumption of Mount Vernon and Daily Consumption Per Capita.

	1906	1907	1908	1909	1910
Est. Pop. of Mt. Ver'n	27,043	28,012	28,981	29,950	30,919
Total Annual Water Supply in Million Gallons:					
Mamaroneck Sta.....	698.4	867.9	698.8	855.9	910.0
Pelhamville Sta.....	144.7	127.8	259.2	178.0	224.2
Tarrytown Supply.....	.....	.....	.....	41.5	49.4
N. Y. City Supply	.....	.....	.....	.....	44.7
Total	843.1	995.7	958.0	1,075.4	1,228.3
Less 0.5 M. G. daily*	660.6	813.2	775.5	892.9	1,045.8
Less 5% slip.....	627.6	772.6	736.8	848.3	993.5
Mt. Vernon Water Supply:					
M. G. per Annum..	627.6	772.6	736.8	848.3	993.5
Gals. per cap. daily..	64	75	70	78	88

* Estimate of Water Company of consumption of Mamaroneck, Rye Neck, Harrison and Pelham Heights.

In considering the water consumption, it is necessary to bear in mind that the total quantity of water delivered into a distribution system is considerably in excess of the sum of the volumes of water used by the individual water consumers. In fact, the summation of all meter readings in communities supplied entirely by meter seldom amounts to more than 70 per cent. of the total volume of water delivered into the water works system. In no instance do we know of a plant, comparable in size with that of Mount Vernon, where the meters of the consumers account for as much as 80 per cent. of the total pumpage. Frequently it is between 60 and 65 per cent. and in some cases it is even less than 60 per cent.

The reason of this is to be found in the leakage in the pipe systems and the consumption of water for public purposes that are not metered, such as flushing sewers, fountains, and other reasons which it is not necessary to discuss here.

At present in Mount Vernon about 88 per cent. of the water consumers are equipped with meters. It is our opinion that a volume of water delivered into the pipe system equal on an average to 100 gallons per capita daily is a liberal allowance for future requirements of Mount Vernon. With care its supply could be limited to appreciably less than this.

Applying this volume of water per capita daily to the population estimates above given, it is seen that, if Mount Vernon is to go into the water works business and is to look ahead as is ordinarily the case in such projects for a term of 25 to 30 years, it is wise for the city to decide upon means by which a water supply could be secured equivalent to a daily yield of about 7.5 million gallons. It is not necessary, however, to provide so large a supply at present.

The City of Mount Vernon, independently of the neighboring communities supplied by the New York Inter Urban Water Co., is apparently using about 2.5 million gallons daily on an average. It is our conclusion that in the study of this water supply project, provision should be made at once for securing a supply equal to about double the present requirements of Mount Vernon and that ultimately about three times this volume should be provided.

The outside communities of Pelham Heights, Mamaroneck, Harrison and Rye Neck now have 1,656 consumers in the aggregate, as compared with 5,416 consumers in the City of Mount Vernon. This shows that 20.2 per cent. of the consumers are now outside of Mount Vernon and the data in Table 3 indicate that about 17.5 per cent. of the water is consumed by them.

Notwithstanding the fact that the outside communities, together with Mount Vernon, will obviously increase in population much more rapidly than given above for Mount Vernon alone, we are of the opinion that is is not necessary now to figure upon supplying permanently the outside communities. That matter can receive its final decision in later years as conditions shape themselves more definitely than can now be forecasted.

In this connection it is also to be borne in mind that the City of Mount Vernon and other communities may in a few years secure their water, if they so desire, from the City of New York, and particularly during the dry seasons of the year when the small watersheds in and about Westchester county might be overtaxed for short intervals.

As regards the quality of the water now supplied by the New York Inter Urban Water Co., the available data indicate it to be good from a hygienic standpoint. This is in harmony with the vital statistics of the community with respect to the prevalence of typhoid fever and other intestinal diseases and it is also in line with the results of analysis made weekly by the Lederle Laboratories of New York City, A summary of the monthly averages in 1910 of the quality of the water before and after filteration at the Mamaroneck station of the New York Inter Urban Water Co., is given in Table 4. The bacterial results are expressed in numbers per cubic centimeter and the turbidity and alkalinity results are given in parts per million.

TABLE 4.

Showing Rqsults of Monthly Averages of Analysis of Mamaroneck.—River Water.

Date.	Bacteria.		Turbidity.	Alkalinity.	
	Raw.	Filtered	Raw.	Raw.	Filtered.
January, 1910.....	4,357	108	19	35	27
February, 1910	2,233	73	34	28	21
March, 1910	640	78	18	30	22
April 1910	764	40	27	38	32
May, 1910	501	19	17	41	36
June, 1910	969	64	21	37	31
July, 1910	570	70	10	55	46
August, 1910	1,528	99	30	61	46
September, 1910 ..	612	80	35	64	51
October, 1910	732	12	10	61	46
November, 1910 ..	2,570	135	19	54	43
December, 1910 ..	5,428	107	14	51	41

We find that the water from the Mamaroneck station is sterilized by the hypochlorite method and while it is understood that at times the tap water has rather an undesirable amount of color and turbidity, seemingly due in part at least to the stirring up of deposits in the pipe system, it seems fair to conclude that with good management there should be no serious objection to the filtered water supply from the present sources.

Pressure. The general elevation of the surface of Mount Vernon ranges from 20 to 170 feet. At the base of the standpipe the ground is about elevation 134 and the top of the standpipe is at about elevation 259. There are places on the high ground where difficulty is experienced in getting sufficient pres-

sure of water above the first floor, but it is believed that a few reinforcing pipes would obviate this trouble to a considerable extent. An improved water supply for the city, however, should provide a somewhat greater pressure than at the present time.

We will next proceed to discuss the relative merits of the various propositions which the city has placed before us for consideration and advice, and we shall view the same in the light of providing in the early future a supply of some 5,000,000 gallons of water daily, equal to about double the present supply of the City of Mount Vernon, and ultimately of providing a supply of about 7,500,000 gallons daily, or roughly three times the present supply for the City of Mount Vernon.

PROPOSITION 1.

Economy and Suitability of Obtaining a Future Water Supply From the Existing Sources of the New York Inter Urban Water Company, Supplemented by Additional Storage East of the City.

It is highly important at the beginning of this discussion to fix clearly in mind that there is a definite relation between the flow of rivers and the precipitation on the watershed as rain or snow. A part of the water reaching the surface of the earth sinks into the ground and becomes ground water or well water; part of it flows off to the ocean in streams, and the remainder is evaporated. In connection with storage reservoirs, also, it is important to bear in mind that evaporation is a large factor. Indeed evaporation from the surface of a body of water causes in the course of a year a decrease in amount substantially equal to the increase from the rainfall on the water surface. In other words, evaporation in storage reservoirs aggregates more than 40 inches per year, of which the greater part takes place during the summer months.

The rainfall, runoff and yield of storage reservoirs are figured in this report largely on the experiences obtained for more than 40 years from the Croton watershed of New York City and the Sudbury watershed of Boston, Mass.

On an average the runoff for each square mile of watershed in this locality approximates 1,000,000 gallons of water daily. The fluctuation in flow is very wide. During extreme floods the runoff sometimes reaches as high as 100,000,000 gallons daily per square mile. At times of protracted drouth the flow is correspondingly small, as was noticed in the Mamaroneck river last October when the flow of the river for the entire month averaged only about 32,000 gallons daily per square mile. On some days it was much less than this.

Obviously it would be necessary to provide storage on the Mamaroneck river to meet the present consumption and in providing this storage it would be necessary to take into account the

losses of water by evaporation as well as by the withdrawal of water from the reservoir for purposes of consumption.

Taking into account the conditions of rainfall and evaporation substantially as they are found to exist upon the Croton and Sudbury watersheds, we consider that Table 5, prepared some years ago by the Massachusetts State Board of Health, gives a good indication of the general relation between the extreme dry-weather yield of a watershed and the varying amounts of storage per square mile of watershed and on the basis that the area of the water surface is approximately 3 per cent. of the total watershed. More recent data, particularly those prepared by Mr. John R. Freeman in his investigation of the Croton supply in 1900, show some further refinements, but for present purposes Table 5 will be sufficient in fixing the relationship between storage and runoff per square mile of watershed. It then becomes necessary simply to apply the table to the total area of watershed available to determine the amount of storage needed in order to indicate the amount of water which it is desired to obtain.

TABLE 5.

Relation Between Continuous Dry-weather Yield and Necessary Storage per Square Mile of Watershed.

Daily Yield in Gals. per Square Mile.	Storage Required, Gals. per Square Mile.
100,000	3,000,000
150,000	7,100,000
200,000	11,700,000
250,000	22,200,000
300,000	33,000,000
400,000	54,400,000
500,000	77,300,000
600,000	104,600,000
700,000	153,000,000
800,000	210,900,000
900,000	349,200,000
1,000,000	516,700,000

We will now proceed to the consideration of the volume of water that may be secured with the aid of storage in an economical manner from the several watersheds in which the present Water Company is interested, as well as some others in and near Westchester county.

PELHAMVILLE SUPPLY.

We have given consideration to the Pelhamville supply, but find that it has not sufficient watershed area either along Tom Payne brook or Hutchinson creek, after excluding an area of 3.4 square miles utilized by the New Rochelle Water Co., to make

it much of a factor in securing the supply required for the city of Mount Vernon.

Perhaps it would be well at this point to note that the value of the real estate holdings of the present Water Company in connection with the Pelhamville property is such that their usefulness in these developments is practically over, because their continued use for waterworks purposes would be less advantageous than for sale at their appreciated present value as real estate.

So long as the Mamaroneck river without storage furnishes the main source of supply for the present Water Company, it is, of course, true that the 90,000,000 gallons of water stored in Tom Payne brook is of value. It is also true that the flow of Hutchinson creek is of aid in maintaining the city supply under present conditions. But under the conditions of development of the whole waterworks proposition for the future in an economical manner an ample supply could only be obtained advantageously in connection with other sources. Hence these small watersheds of Hutchinson creek and Tom Payne brook fall out of the reckoning on account of their size and the impossibility of developing sufficient water from them without also using more distant sources.

Another useful purpose which the Pelhamville plant temporarily serves is that of a reserve or standby to take care of the needs of the City of Mount Vernon in the event there were a break in the force main between the Mamaroneck station and Mount Vernon. This is not a purpose that the Pelhamville plant could be used for permanently. It is only a question of time when a duplicate line from Mamaroneck would be required in event that at the Mamaroneck station the water in its vicinity or east thereof should be needed for the supply of Mount Vernon.

Accordingly we will dismiss the Pelhamville property, including the Tom Payne brook reservoirs and pipe line, as being entirely lacking in economy and suitability, with respect to forming by itself the future water supply of Mount Vernon.

Before proceeding to consider other sources, however, it will be well to record our conclusions in the matter of the value of these properties and in which we have availed of the data on real estate values as furnished on August 7 and 12, 1911, by your Board in co-operation with local real estate experts who are far more familiar than we are as to land values in that district.

Pelhamville Valuation. The total value of the real estate of the Pelhamville plant adjoining the N. Y., N. H. & H. R. R. tracks and the rights of way for the pipe line from said Pelhamville plant to the Mahlstedt and Lester reservoirs on Tom Payne brook, is given as $298,822. We estimate that it would cost to duplicate the pumping station, filters, pipe lines, and the Lester and Mahlstedt reservoirs, approximately $244,558. As to the depreciation of all the water works improvements in connection with the Pelhamville property above mentioned so far as wear and tear are concerned, we place the figure at approximately

$46,178. This does not tell the whole story, however, because the present plant has practically outlived its usefulness as explained above, and its functional depreciation causes its value for water works purposes, in our opinion, to be practically no greater than its real estate value, assuming for real estate purposes that it could be sold to good advantage. We give the value, therefore, of the Pelhamville and Tom Payne brook property as $300,000, and express our firm belief that whether the ownership should remain with the present Water Company or should be vested in the City of Mount Vernon, it would be advantageous to sell it rather than to continue to hold it for water works purposes beyond the period when other means should be provided for securing the benefit now afforded by the Pelhamville plant.

What worth the Pelhamville plant is entitled to in consequence of the standby service during the period needed for developing storage reservoirs elsewhere and building the duplicate force main, is a point upon which we will not enter at this time. After a new supply is developed the site of the Pelhamville plant offers some advantages for a new pumping station, as will be discussed later. But even in the case of a Byram river supply, the disadvantages would more than offset the advantages of this site.

MAMARONECK RIVER PLANT.

This plant, located a mile and a half north of the village on the Mamaroneck river where the drainage area is about 15 square miles, is a useful and serviceable plant except insofar as its utility is very seriously handicapped for lack of sufficient water to pump into the mains at times of dry weather. It is possible, as noted on page 94 of the Sixth Annual Report of the State Water Commission for the year ending December 31, 1910, to develop storage on the Mamaroneck river to an extent which should take care of the needs of the City of Mount Vernon up to the limits considered necessary within the next 25 or 30 years and as already set forth in this report: namely, a development in the early future of about 5 million gallons dry-weather daily yield and an ultimate development of about 7.5 million gallons dry-weather daily yield. In fact, the State authorities report an ultimate yield of 9.5 million gallons and we agree with this conclusion.

Present Valuation. We estimate the cost of reproducing the Mamaroneck station, including dam, pumping station with all machinery, filter plant, lands, water rights and rights of way for the 16-inch force main from the pumping station to the city of Mount Vernon, at $422,371. From this sum should be deducted about $12,371, representing our estimate of the depreciation due to wear and tear, leaving the present value of the Mamaroneck plant at about $410,000.

Sanitary Aspects. On the drainage area of the Mamaroneck river above the pumping station, there is a growing population

for the most part rural in character. If the water were to be supplied to the citizens without filtration, or with but poor or inefficient filtration, we should regard it as a questionable source of supply. But we do not see how Mount Vernon can secure in or around Westchester county any surface water supply which would be permanently satisfactory without efficient filtration and purification. Such purification would offset the effects of surface drainage from the population upon the watershed of the Mamaroneck river and make the water thoroughly pure and wholesome. In fact, New York City after having spent many millions of dollars in the Croton watershed to eliminate the pollution by the purchase of real estate and elimination of buildings, has come to filtration of the Croton supply, partly for hygienic reasons and partly in order to secure clean and attractive water at all times. We have no hesitancy in saying that under the existing laws for the prevention of pollution, and with a good filtration plant, the Mamaroneck river is a favorable source of supply for the City of Mount Vernon. If the present plant were to be purchased, we would favor a number of improvements in the filter plant which would provide a more uniform flow of water through the plant and a more uniform application of the chemicals for the elimination of bacteria and color. In some ways it would be preferable to adopt a gravity type of filter rather than the existing pressure filters, but this is not an urgent matter for consideration at this time.

Storage. On the Mamaroneck river there are at least two good sites where storage reservoirs could be constructed to advantage. One is about 500 feet north of where West street crosses the Mamaroneck river and the other about 700 feet north of North street. Dams at either one of these sites with improvements at the pumping station and enlargement of the present reservoir would allow sufficient water to be secured by the City of Mount Vernon for a dozen years or so. With the upper dam constructed with its spillway at an elevation of about 125 feet, sufficient water could be secured to take care of the needs of Mount Vernon for the next 25 or 30 years. That is to say, with improvements at the pumping station and vicinity and with storage reservoirs at either of the above mentioned places, it is possible to secure a water supply of 5 million gallons daily, and with improvements at the pumping station and dam at the upper location with its flow line at elevation 125, it is possible to secure a supply of 7.5 million gallons daily. These quantities are stated with respect to dry-weather yield and if water could be secured from New York City for severe dry-weather periods which may occur during one or two years in a generation, these yields above stated could be increased quite materially.

At the location of the present reservoir of the Inter Urban Water Co. near the pumping station it would be necessary to construct a new dam of concrete masonry of sufficient height (about 20 feet) so that the reservoir above it would have a capacity of about 100 million gallons. It is also possible at this place to build

a dam of such height (about 30 feet) that some 400 million gallons of water could be stored, but this would necessitate the changing of the location of the highway and the trolley tracks for a distance of about 6,000 feet. The construction of a lower dam which would flood to within about 3 feet of the present level of the highway would be preferable in our opinion. Such a reservoir would store the water from the summer showers on the watershed above and would be sufficient to take care of any fluctuations in the consumption of water during short periods. Of the two available sites above the present dam, the upper site, which is some 13,000 feet upstream from the waterworks pumping station, is preferable. A concrete dam with its spillway at about elevation 115 would be sufficient to take care of the needs of the city for some years to come. Ultimately this dam could be raised to a height of about 43 feet with its spillway at an elevation of 125 feet, which would give a storage of about 1,000 million gallons of water. This reservoir would be about 1,000 feet wide at the widest place and would extend back for a distance of about 3 miles from the site of the dam.

The estimated cost which you obtained for us of the real estate, which it would be necessary to purchase in order to carry out this project, becomes a considerable item of expense. We have prepared estimates which indicate that with a reasonable allowance for real estate, according to the estimates mentioned above, a 5-million gallon daily supply could be obtained from the Mamaroneck river, including the necessary changes and additions in the existing pumping station, dam and filter plant, and with a new 24-inch force main extending to Mount Vernon for the sum of $902,360.

With proper additions to the dam as above mentioned, and with additions to the pumping station and filters, a 7.5-million gallon supply could be obtained from the Mamaroneck river for an additional cost of about $207,825, including real estate, or a total sum for the new supply works of $1,110,185. These sums do not include the purchase of the existing works of the New York Inter Urban Water Company.

This report on the development of storage on the Mamaroneck river has been prepared on the basis that there could be made available the entire drainage area of the Mamaroneck river above the present pumping station of the New York Inter Urban Water Co. We are aware that the village of White Plains made application a few years ago for utilizing for its water supply some 2.3 square miles of the drainage area of the east branch of the Mamaroneck river. An injunction was obtained against this step by the New York Inter Urban Water Co. Should this injunction become permanently dissolved and White Plains actually utilize the area above stated, it would cause a modification in the yields given in this report. It would still be possible, however, to develop a dry-weather yield of 7.5 million gallons daily from the remaining area of a little more than 12 square miles.

BYRAM RIVER.

Just across the State line in Connecticut is the Byram river, from the west branch of which the city of New York obtains a portion of its supply by diversion to Rye lake. From the information furnished us by you it appears that it is feasible to secure the legal rights to obtain water from the Byram river for the needs of Mount Vernon and in accordance with your instructions we have proceeded to investigate this matter as regards reservoir sites, volume of water stored, elevation of the flow line when the storage reservoir is full and when it is drawn down, and means for delivering water to the existing plant of the New York Inter Urban Water Co. at Mamaroneck.

There are three branches to this river, designated as the West, Middle and East branches. The West branch has a watershed, exclusive of that utilized by New York City, of about 3.6 square miles, according to the Government maps. A dam located on this branch with its spillway at elevation 265 would provide a storage reservoir which would hold about 270 million gallons. This dam would be about 350 feet long, about 50 feet high, and would flood about 40 acres. The water would be conveyed by a canal to a proposed main reservoir on the Middle branch above the junction of the Middle and West branches of the river, and just below the junction of the Middle and East branches. With a dam just below the present ice pond on the Middle branch, a reservoir could be constructed which could store about 2,000 million gallons of water. The total watershed area of the Middle and East branches is about 12 square miles, according to the Government maps. It is understood that the local Water Company at Greenwich, Conn., contemplates building a reservoir on the East branch, near the road leading to Round Hill. The watershed of the East branch above this point is about 4.9 square miles in area, leaving about 7 square miles tributary to the reservoirs. Should dams be built on the Middle branch and on the West branch, as indicated, it would be perfectly possible to obtain a daily supply of about 7.5 million gallons of water without utilizing the upper part of the East branch.

To store 2,000 million gallons of water would require on the Middle branch a dam about 80 feet high in the highest place with a spillway at an elevation of about 230 and low water at the end of the dry season in the reservoir would be at about elevation 180. The dam would flood about 300 acres.

To store sufficient water in the main reservoir so that a daily supply of 5 million gallons could be obtained from the total area of 12 square miles on the Middle and East branches would require a dam about 65 feet high, storing about 800 million gallons.

The available head would be such that it would be simple to deliver water by gravity to the Mamaroneck pumping station (elevation about 45 feet), through a pipe line about 57,400 feet long. With water in the main reservoir at elevation 180., a

24-inch pipe would deliver 6.4 millions gallons daily and a 30-inch pipe about 11.4 million gallons daily.

At the Mamaroneck station it would be necessary to establish a modern filter plant to provide water of proper hygienic quality and appearance. In fact, there would be needed substantially all of the developments and improvements at the pumping station and force main to Mount Vernon that have been described above for the development of the Mamaroneck river project. Of course, the storage reservoirs, as described, would not be needed, but it would be necessary to provide some storage near the Mamaroneck pumping station in order to guard against interruption in the supply in the event of a break in the pipe line from Byram river. Such storage would also be of aid in meeting the irregular rates of water consumption as compared with the uniform rate of flow through the pipe line, when it delivers at full rate at times when the main reservoir is at a low stage.

It is not feasible to deliver water by gravity from Byram river to the Pelhamville plant, because its cost would be too great for a pipe line large enough to deliver the needed volume of water at the low head available. Double pumping would be obviously objectionable.

We have inspected the watershed and reservoir sites and we have made surveys for a pipe line, as shown on the accompanying maps. From this survey we have obtained checks upon the elevations of the Government maps. There are quite a number of houses on the ridge road in the watershed, especially at the little village of Round Hill. The valleys are comparatively free of swamps.

We estimate as a result of our studies that the development of a 5-million gallon daily supply, on the supposition that the entire 12 miles of watershed of the Middle and East branches could be utilized, would cost, including real estate, reservoir (800 million gallons), water rights, one 24-inch force main to the Mamaroneck pumping station, and compensation to the present owners of the reservoir site, about $1,055,000. The estimated cost of purchasing the present Mamaroneck plant, $410,000, and of additions to the Mamaroneck plant, $452,258, would make a total of $1,917,258.

Should it not be feasible to obtain water from the upper part of the East branch, then a higher dam (74 feet) with greater storage (1,400 million gallons) would have to be built for the main reservoir which, with the increase in the amount of land needed, would add about $182,436 to the investment, or a total estimated cost of $1,999,694.

A 7.5-million gallon daily supply could be obtained for this last figure, if the 4.9 square miles of watershed were available at the upper end of the East branch. Without this additional watershed, it would be necessary to obtain water from the West branch and bring it by canal to the larger reservoir (2,000 million gallons.) We estimate that this would cost for the main res-

ervoir and the West branch reservoir, two 24-inch force mains to the Mamaroneck station, land, rights of way, water rights and compensation to the present owners of the reservoir sites, about $1,713,666. To this must be added the cost of purchasing the Mamaroneck station, $410,000, and development of the Mamaroneck station, $527,858, or a total of $2,651,524.

OTHER WATERSHEDS EAST OF MOUNT VERNON.

It is futile to consider watershed areas further east than the Byram river, as their cost would be greater as a source of supply for the City of Mount Vernon than would be watershed areas nearer to the city; and there would be no advantages to offset the increased cost.

Between the Byram river and the City of Mount Vernon there are two streams which we have examined and to which we will make brief reference as a matter of record.

Between Hutchinson creek and the Mamaroneck river is a small stream known as Shelldrake river, from which a small supply is obtained by the Larchmont Water Co. The drainage area of this stream at Shelldrake lake is about 3.2 square miles. Obviously it is too small to receive attention in this report.

Between the Mamaroneck river and the Byram river is Blind creek which we have examined with some care. Above the village of Port Chester it has a drainage area of a little over 7 square miles. An available reservoir site exists on the main stream above Port Chester and another site is near the village of Purchase on the branch spoken of locally as Purdy brook. From these two storage reservoirs it would be possible to obtain a dry-weather yield of about 4.5 million gallons daily.

We have eliminated Blind creek from detailed consideration, partly on account of its being too small in size and partly on account of its expense. The water from the main reservoir on this creek could not be delivered by gravity to either the Mamaroneck or Pelhamville pumping stations of the New York Inter Urban Water Co. Hence double pumping would be necessary if this watershed were utilized in providing supplementary storage to increase the supply from the existing sources.

PROPOSITION 2.

Economy and Suitability of a Water Supply From New York City.

Water from the present sources, that is, from the Croton watershed or from the existing Kensico reservoir, seems to be out of the question for use by the city of Mount Vernon, other than possibly for emergency use at times when the city of New York could spare the water.

As to the Catskill supply, it is expected that it will reach Croton lake, and enter the present piping system of New York

City, in the late autumn of 1913. Contracts also provide that structures should be completed so that it should flow through the Catskill aqueduct to the Hill View reservoir, near the Empire City race track, in December, 1913. The contract date of completion of the Hill View reservoir is April 24, 1916. The law provides that any municipal corporation in Westchester county may take water up to the pro rata quantity used in the city of New York under the conditions set forth in Section 40 of the Laws of 1905, Chapter 724, as follows:

"*Supply of Water to Other Municipalities.* Immediately upon the acquisition of an additional supply of water by the City of New York, under the provisions of this act, or under proceedings instituted after the passage of this act, it shall be lawful for any of the municipal corporations in the County of Westchester to take and receive from any of the reservoirs, aqueducts, conduits, streams or pipes of the City of New York, a supply of water for the uses and purposes of the said municipal corporations.

"The connection with said reservoirs, aqueducts, conduits, streams or pipes shall be made at the expense of said municipalities, and they shall pay to the City of New York water charges or rates in the same amounts as are charged by the City of New York to persons using water in that city. Any such municipal corporation desiring to take and receive water under the provisions of this section shall make application to the proper officer in charge of the water supply of the City of New York in writing, showing the place and manner in which it is propesed to make such connections. It shall be the duty of the said officer to grant a permit or authorization for the said connections, under reasonable rules and regulations, including the installation of proper meters or other devices for ascertaining the quantity of water thus taken. Provided, however, that no greater quantity of water shall be taken by the said municipal corporations than the proportionate quantity that is used by the City of New York, the proportion being calculated according to the number of inhabitants respectively of the said city and municipal corporations as shown by the last preceding census of the United States."

The meter rate above referred to, in connection with the payment to the city of New York, according to Section 282 of the Code of Ordinances of the city of New York, provides a charge of 10 cents per 100 cubic feet of water. This is equal to 13 1-3 cents per 1,000 gallons, or about $133 per million gallons.

It is also to be pointed out that connections with reservoir, aqueduct, conduit or pipe shall be made at the expense of the municipality in Westchester county requesting such connection to be made.

The connection with the Catskill project would probably be made at the so-called Bryn Mawr blowoff, distant from the westerly city line of Mount Vernon about 10,000 feet. When the Hill View reservoir is completed, a connection could be made there which would make a somewhat shorter and cheaper line to Mount Vernon than the connection to Bryn Mawr.

The cost of a 24-inch pipe line from the Catskill aqueduct to connect with the piping system in Mount Vernon would be from $75,000 to $100,000, depending upon the route selected.

The normal elevation of the water in the Catskill aqueduct will be in the neighborhood of 295 feet above tide, which is amply

adequate to give reasonable pressure in the city of Mount Vernon, fully as great as at present.

If water were to be taken from the vicinity of Williamsbridge from pipes connecting with the distributing system of the Borough of the Bronx in New York City, the cost might be less than a connection with the Catskill aqueduct at Bryn Mawr or Hill View. The water pressure in the future at the western city line of Mount Vernon near Williamsbridge is somewhat uncertain, but it would probably be equivalent to that above stated for the Catskill connection at Bryn Mawr or Hill View.

Upon the completion of the Croton filter plant and the introduction of Catskill water, some changes will doubtless be made in the distribution system of the Borough of the Bronx, but it is scarcely feasible to forecast just what they may be at this time. It is also difficult to say what, if any, financial advantage Mount Vernon might take regularly of New York's pipes to the Williamsbridge district.

The Catskill water supply will no doubt be very satisfactory, both as to quality and pressure, and when the contemplated improvements are made the same may be said of the water from the Croton system after filtration.

As to cost, it is our opinion, after looking into the State law creating the Board of Water Supply of New York City, in the matter of the Catskill water supply, that it is considerably higher than would be the case with water from other sources.

It may be that more favorable terms might be secured by agreement or adjustment, but that seems to be a wholly speculative matter at this time. In fact, the Westchester municipalities are much less favorably circumstanced in this regard than are those of Putnam county. The latter have the power to make adjustment with New York city both as to the cost of the water and that of the connections to be made with the Catskill system, as set forth in Chapter 726 of the Laws of 1905, from which the following extract is taken:

"*Acquisition of Lands and Water-rights and the Use of Waters in Putnam County.* Any village or town in the county of Putnam, or a corporation, or person or persons authorized by or in pursuance of law to establish therein a water works system for supplying such village or town and the inhabitants thereof with water, may connect its or their water mains or pipes with the lakes, streams, reservoirs, aqueducts, water pipes and conduits of the City of New York now or hereafter located in such county, and take water therefrom for supplying such village or town and the inhabitants thereof with water. Such connections shall be made in the manner agreed upon between the authorities of such village or town, or such corporation, person or persons, and the Commissioner of Water Supply, Gas, and Electricity of the City of New York, or as directed by a special term of the Supreme Court held in the Secoud Judicial District, upon application made in behalf of such town, village, corporation, person or persons. The amount of water that may be drawn shall not exceed the proportionate amount that is used by the City of New York, the proportion being calculated according to the number of inhabitants respectively of the said city, town or village as shown by the last preceding census of the United States. The amount to be paid to the City of New York for

water so supplied shall be agreed upon between the Board of Estimate and Apportionment of the City of New York and the authorities of such village or town, or such corporation, person or persons, or fixed and determined by a special term of the Supreme Court held in the Second Judicial District, upon application made in behalf of such town, village, corporation, person or persons.

PROPOSITION 3.

Well Supply From Hutchinson Creek Valley.

The first question to be looked into as to a well water supply is that of sufficient quantity to make the project worth while. It is necessary to bear in mind that all water has its origin in the rainfall, and also that a definite relation exists between the rainfall and the runoff which reaches the ocean through the streams, as well as that portion of the rainfall which soaks into the ground and forms what is called "ground water" or "well water."

Where the rainfall approximates that in the vicinity of Mount Vernon it is found that for each square mile of land surface it is possible for some 500,000 to 750,000 gallons of water to be withdrawn through wells or galleries each day from a square mile of watershed, depending on the rainfall. Under the conditions last stated it is also necessary to assume that there is an ample quantity of porous material to store within its interstices a sufficient portion of the rainfall, as it is precipitated, so as to serve for use during periods of dry weather. In fact, it is also necessary to assume that the required quantity of water would be stored within reach of the pumps, and that the pumps withdrawing the water would be spaced at sufficiently frequent intervals so that in prolonged drouths they would be able theoretically to empty what would constitute a large underground storage reservoir.

One of the most valuable lines of observation, based upon experience in well supplies, is that furnished by a portion of the Brooklyn water works. Here a substantial portion of the Borough of Brooklyn derives its supply from numerous wells scattered over a considerable area of the western portion of Long Island, which is made up in large measure of moderately porous sand. The quantities above stated as to the yield per square mile of surface area are substantially in conformity with those found by experience to be available from Long Island supplies.

In some cases yields of ground water may be obtained which look very large in comparison with the apparent drainage area of the gathering ground of the well water. This is due in some instances to a connection through strata of coarse material with large deposits of porous sand and gravel, which are situated outside the apparent limits of the drainage area. In other instances, such as are frequently found in Indiana and portions of the Middle West, sufficient rock fissures permit the flow of underground streams so that rain water may reach wells far removed from the locality where the rain actually first meets the surface of the earth.

In Hutchinson creek valley considerable experience has been obtained with the well water proposition. Part of the data are available from the wells sunk by the New York Inter Urban Water Co. in the neighborhood of the Pelhamville station. More information is available from the wells of the New Rochelle Water Company, located about one-half mile down the valley and from which it is stated that about 1 million gallons of water are pumped daily. Still other information and experiences are available from the recently built wells at the Westchester brewery and from wells sunk by the City of Mount Vernon during the last few months.

At the Pelhamville plant of the New York Inter Urban Water Co., the total drainage area of the Hutchinson creek is 5.5 square miles. In the vicinity of the well plant of the New Rochelle Water Works the drainage area is about 7.8 square miles. From these areas, however, in figuring upon the available ground water, it is necessary to make some deduction for the 3.4 square miles which is the catchment area of the storage reservoirs of the New Rochelle Water Co. with an aggregate capacity of about 445 million gallons. The reason of this is that there is no substantial underground stream in this valley and that at times of dry-weather when the storage reservoirs are more or less depleted, the rainfall upon the upper reaches of the watershed is impounded in these reservoirs and does not reach the lower portions of the watershed. This leaves only about 2.1 square miles of watershed area constantly available for furnishing rainfall in Hutchinson creek valley at the Pelhamville station which is about half a mile above the New Rochelle Water Company's well plant. The indications, therefore, for securing a substantial volume of well water supply as a regular procedure are not promising in any measure, except insofar as related to Hutchinson creek valley receiving underground water through rock crevices from rain which falls some distance removed therefrom; or from the storage of water in porous strata in connection with the salt marshes in the lower portion of the valley.

A full account of the tests and experiences in locating a temporary well plant for emergency use on the city's property in the vicinity of Warwick avenue will be set forth in detail in a full report upon this subject, but briefly a summary of the experience obtained is as follows:

1. The character of the ground is for the most part a medium porous sand from the surface down to where rock is encountered, which is from 35 to 50 feet below the surface.

2. The rock is a hard non-porous variety in which fissures or crevices are lacking as a rule.

3. There seems to be no connection between the rainfall reaching the surface of the ground outside of the immediate drainage area of Hutchinson creek above the location of the

wells and the volume of ground water in this valley. That which falls in the lower valley of this creek below the plant of the New Rochelle Water Company apparently does influence the storage of ground water. The well plant of the last mentioned company, however, is understood to draw at times as much water as it is possible to obtain and still maintain the supply substantially free from the influences of salt water.

4. As to quality, the water from test wells and that obtained from some other deep wells in the vicinity appears to be satisfactory, although the hardness is materially greater than that of the surface waters in the neighborhood as now supplied to Mount Vernon and neighboring cities.

5. The apparent available storage of water beneath the ground in the vicinity of the wells recently driven by the City of Mount Vernon probably does not exceed 50 million gallons and it may be considerably less. By extending the wells over a greater area the amount of water could presumably be increased within certain limits, but the well water plants of the brewery on the north and of the New Rochelle Water Co. on the south give no opportunity of figuring upon such a municipal plant as would be servicable for other than temporary purposes.

6. Such a well plant would be expensive to maintain at best, and in our opinion the quantity is too small to be considered in connection with reinforcing with water from New York City so as to make these two combined sources serve advantageously as the supply for Mount Vernon's needs in the future.

PROPOSITION 4.

Desirability of Purchasing the Entire Plant of the New York Inter Urban Water Company.

On the proposition as to whether it is better for the City of Mount Vernon to buy the old works or to build complete new works, our views are clear that if the city can buy the present works at a fair price, it is by far the wisest thing to do.

If the purchasing price is not too high, there are no disadvantages in buying the present plant in the event that it is decided that the city wants to go into the municipal water works business.

The advantages, on the other hand, of buying the old works as compared with building new works are several, among which may be mentioned the following:

a. It aids in securing a good public water supply as to quality and quantity with a minimum of delay.

b. It averts the possibility of ruinous competition, such as would result disastrously to both the city and the water company if each tried to supply the city with a plant of its own.

c. It avoids expensive and protracted litigation as to injunction suits which almost without question would follow at once any attempts by the city to proceed actively in the wholesale construction of a complete municipal water works plant.

d. It meets all moral obligations which may face the city and leaves the city with clean hands on the score of wrecking property through needless duplication.

e. It avoids possibilities or probabilities of doubt being thrown upon the city's credit in connnection with the marketing of its bonds, such as would come up with the marketing of securities for a duplicate plant. If attempts were made to float bonds for such a purpose, experience elsewhere indicates that circular letters addressed by capitalists to all the principal bonding houses in the country might constitute an embarrassment to a serious and far-reaching extent for the city.

f. It would enable the city to go into the water works business with a smaller investment than would be required if a complete new plant were to be built. This is due to the fact that the item of depreciation on the present plant amounts to quite a sum. Again, on the distribution system, if a new plant were to be built, there are many of the pipes which would undoubtedly be larger so as to provide more adequately for future growth, and many of the pipes in the outlaying districts would be made larger and would be cross-connected. Such cross-connecting will sooner or later have to be done with the present pipe system, but it is possible to do it piecemeal to an extent that is greater than would be actually done in practice in building complete new works.

g. It saves the city the great annoyance of cutting up its streets, particularly all of its paved streets, in order to allow new street mains to be built.

h. It saves the consumers the annoyance of shifting house connections or service pipes from the old to the new street mains. In the event of competition the city would undoubtedly be obliged to pay for changing the connections, otherwise the consumers might remain with the old plant. Indirectly this cost would fall upon the citizens in the shape of taxes, notwithstanding the fact that they now own the service pipes connecting to the existing mains.

On the proposition of purchasing the entire plant of the New York Inter Urban Water Co. as distinguished from purchasing a portion of the plant, it is our view that it would be desirable, all things considered, to purchase the plant as a whole in the event that condemnation proceedings are resorted to. Should it be feasible to negotiate or agree upon a price, it might be feasible to eliminate certain portions of the plant by mutual consent. Perhaps this might also be done on a condemnation

procedure, but as a general proposition it is our view that the City of Mount Vernon would pay nearly as much for a substantial part of the plant as they would for the whole plant, in view of the interpretation sometimes placed upon consequential damages or upon what is sometimes called "damages due to severance." This is predicated on the thought that the Water Company would claim that a small residue of their plant would be of but very small value to them.

We are aware that the purchase of the entire plant of the water company would involve the carrying out for a time at least of the present arrangements of the water company for supplying water to Mamaroneck, Harrison, Rye, etc., but we think that that would be a fairly simple thing to do. If desired, arrangements could probably be made so that ultimately the City of Mount Vernon could wholesale water to these communities, who would own their own distributing pipes.

As to the Pelhamville plant and the reservoir on Tom Payne brook, their usefulness now is practically that of a standby or reserve in the event of a break in the long force main coming from the Mamaroneck pumping station. With an ample quantity of water developed by the city and with a duplicate force main, there is no reason for keeping the works on Tom Payne creek or Hutchinson creek. It is our understanding, however, that the value of these holdings as real estate alone is such that they could be disposed of at a comparatively early date, regardless of whether the works are owned by the municipality or by a private company.

Taking everything into account, it is our opinion that it would be desirable to purchase the entire plant of the New York Inter Urban Water Co and then later decide what, if any, portions can be disposed of after extensions are made to provide an adequate supply for the future needs of the city.

PROPOSITION 5.

Comparison of Municipally and Privately Owned Waterworks For Mount Vernon.

This proposition can be best discussed by starting out with the assumption that it is theoretically possible for Mount Vernon to be furnished with a public water supply that is thoroughly satisfactory by means of works which may be owned either by the municipality or by a private water company. The advantages and disadvantages of each style of waterworks ownership can then be best set forth by a brief discussion and comparison of the leading features in the premises.

It must also be assumed at the outset that in the future Mount Vernon will be supplied with water which is not only satisfactory in quality and in pressure as delivered to the consumers, but which is reasonable as to price. Judging from the general trend of municipal affairs and public utilities in this country, the inclination for the great majority of American cities is to own their own public waterworks. This seems to be due partly

to a desire to reduce water rates where the source is satisfactory and partly to a wish to correct shortcomings in the service without delay. Sometimes it is due to a combination of the two, and in other instances to the desire to control without outside influence a public utility which is so closely related to the comfort and health of the citizens.

A disadvantage of municipally-owned waterworks, generally speaking, is that in many States it curtails the borrowing capacity of the municipality and causes a slower rate of development in certain public improvements, the cost of which is met through bond issue. In New York State this is not a factor, as the issuing of bonds upon municipally-owned waterworks does not modify the total bonded indebtedness which the municipality may legally incur.

Originally a large portion of communities in America were supplied by privately-owned waterworks plants. Apparently this was to some extent due to the feeling that the ventures were somewhat hazardous and uncertain, with a consequent timidity upon the part of municipalities to venture upon this branch of "municipal trading."

Private water companies have not by any means earned so much money, generally speaking, as is thought by many citizens to have been the case. It is true, nevertheless, that water companies are conducted for the purpose of making profit on their investment, and that the rates of interest which they have to pay on the capital employed in their water works business is usually greater than that paid on municipal bonds issued by cities for water works improvements. Hence there is a tendency for water charges to be less with a municipality-owned plant than with a privately-owned plant, other things being equal. This does not hold true, however, in all instances, even where the service is substantially identical in character and extent. The question of water rates is filled with many peculiarities and irregularities, and the charges by municipally-owned plants are in many instances capable of much improvement from a business standpoint. Especially are published rates apt to be misleading unless it is known whether the plant is aided by taxes as to interest or sinking fund charges.

At Mount Vernon the problem of a public water supply, to give satisfactory service, is one which requires for its solution a considerable expenditure of money at once, regardless of whether it is the municipality or a private company that expends the funds. The existing works are inadequate and must be extended.

To do this through municipal ownership is entirely feasible without cramping the bonding capacity of the city for other improvements in any way.

On the other hand, if the ownership is to continue with a private company, new extensions to the water works system mean that a new contract for a term of years, perhaps 30 years, for hydrant service for the city of Mount Vernon would have to be made. Such contract between the city of Mount Vernon

and the water company would provide no assurance that the water consumers may enjoy any reduction in water rate. In fact, there is no guarantee that the water rates may not be increased during the life of a new contract. If a long-term contract were made with the New York Inter Urban Water Co. by the city of Mount Vernon for hydrant service, such as would suffice in allowing needed securities to be issued by the company for increasing the water supply to meet present requirements of the city, it might be contended by some that it would still be a question of good faith and confidence as to whether the water company would for a long term of years give satisfactory service.

The above lead to a reference to the mooted question of the comparative likelihood of a community suffering from lack of efficiency in the management of a privately-owned plant as distinguished from a municipally owned plant. On the one hand private ownership may fail to meet requirements through inability to secure necessary contracts or legislation required for issuing bonds from time to time; and it is also within the limits of possibility that if a company had sufficient funds it would not provide a suitable management to take care of the works. On the other hand, it is claimed that some American cities allow politics to creep into the management of water works plants, with just as bad results as with the privately-owned property. The whole question is largely one of confidence and good faith to be determined by those most vitally interested.

Since the expiration in December, 1908, of the contract between the city of Mount Vernon and the New York Inter Urban Water Co., the city is now under no contractual obligation to the water company. As it appears to be the desire of the city to remain as an independent municipality, rather than to unite with neighboring communities, the present is clearly the time when a solution should be made of the question of municipal ownership. To allow this rapidly growing community to drift along without definite steps to provide for all its reasonable needs as to water supply for some years to come, seems to us to be inadmissible.

Assuming that the city is properly officered with men who are capable of giving good management to a water works plant, then under this reasonable assumption there is no doubt that a municipally-owned water works system under the existing local conditions would be preferable to a continuance of private ownership.

PROPOSITION 6.

Comparison of Different Sources of Future Water Supply.

This proposition involves a comparison of the relative advantages and disadvantages of obtaining a future water supply for Mount Vernon, suitable in quality, quantity and pressure, from New York City, from the present works of the New York Inter Urban Water Co., supplemented by storage either on Mamaroneck river or on Byram river, and also from wells in

Hutchinson creek valley, supplemented by water from New York City.

From what has already been stated under Proposition 3, we may dismiss the well water project in Hutchinson creek valley on the ground that the available quantity is too small to constitute an important part of the future water supply for a community so large as the City of Mount Vernon. Whatever merit the well water project possesses is confined to emergency use. A water supply from New York City, as a regular procedure, would be more economical and advantageous than would be a combined supply, partly from well water and partly from the supply of New York City. Taking all the evidence into account, therefore, we dismiss the well water project from consideration as a regular part of the future water supply of Mount Vernon.

A water supply ample in quantity and under satisfactory pressure could be obtained from the Catskill supply of New York City by tapping the Catskill aqueduct near the Bryn Mawr siphon, or by connection with the Hill View reservoir. Contracts provide that Catskill water will be regularly available at the Bryn Mawr siphon and in the Catskill aqueduct near Hill View in December, 1913, and that the Hill View reservoir will be completed in April, 1916. An ample supply as to quantity and pressure could also be obtained either from the Mamaroneck river or Byram river for the needs of Mount Vernon during the next 25 or 30 years, when the population is assumed to reach about three times the present population. The estimates of the cost of constructing and operating the necessary works for obtaining the supply of Mount Vernon during the next generation from each of these three sources have been stated in some detail under Propositions 1 and 2. In the next table is given a summary of these estimated costs.

We have included in these investment costs in each instance not only the new works necessary for providing, first, a 5-million gallon and later a 7.5 million gallon supply daily, but also the estimated cost of purchasing the existing water supply works of the New York Inter Urban Water Co., both the Mamaroneck station complete and the force main leading into the City of Mount Vernon, and also the plant at Pelhamville and the reservoirs on Tom Payne brook, with connecting pipe line to the Pelhamville plant. With either project developed, we believe that in a fairly short time the Pelhamville plant and Tom Payne reservoirs can be sold as real estate at the figures given in the following tabulation. This would mean that there would be a deduction sooner or later of some $300,000 from the total investment needed for the development of the supply from each of the three sources given. We include this sum, first, because we believe it is wise for the city to take the entire property of the New York Inter Urban Water Co. rather than part or none of it, for the reasons given under Proposition 4. In the second place, we believe that the full list of costs should be here given,

partly with a view of giving full information to the taxpayers and partly to show the amount of the total bond issue which would have to be provided in the early future unless a prompt sale of the real estate at Pelhamville and on Tom Payne brook were definitely assured. In any event, the facts will be clearly understood with these explanations, and any modification that others may desire to make should be a comparatively simple matter.

The precise language of your instructions refers specifically to a supply to the area within the city limits of Mount Vernon. It makes very little difference, as distinguished from supplying some of the other communities now furnished with water by the New York Inter Urban Water Co., whether the supply is taken from the Mamaroneck river or the Byram river. The pressure maintained by the pumps at the Mamaroneck pumping station would be adequate for Mount Vernon and for all other communities. As regards the New York City supply, however, a gravity flow from the Catskill aqueduct would maintain a pressure very similar to that now obtained when the present stand pipe is full. Friction through the pipe lines to the east of Mount Vernon would probably cause some shortages in pressure in those communities, and we have provided for an automatically-operated electric pump to boost the water at Mount Vernon, as needed, to provide adequate pressure east of Mount Vernon. This cost of this is so small that it does not affect the investment to any substantial degree.

We are inclined to favor the furnishing of water by Mount Vernon to the other communities now supplied by the New York Inter Urban Water Co. In fact, if they were eliminated it would not effect much of a reduction in the investment cost to the City of Mount Vernon in providing for their own future requirements. And in the early years of a municipal plant for their own service there would be a considerable revenue derived from the sale of water to consumers at Pelham Heights, Harrison, Rye Neck, etc. This statement is true regardless of whether the City of Mount Vernon should prefer to sell water at retail to each consumer, or whether they would prefer to make arrangements to sell the outside piping system to each respective community and then sell water by wholesale to each of the communities. Ultimately the city of Mount Vernon could use its own supply for itself alone, or continue to deal with the other communities mentioned as it sees fit under the conditions existing in the future. We will not try to cross that bridge at this time.

TABLE 6.

Summary of Estimated Investment Costs of Water Supply Works for Securing a 5-Million Gallon and 7.5-Million Gallon Daily Water Supply for Mount Vernon from Several Sources.

From New York City:	5 M. Gals.	7.5 M. Gals.
Purchase of Pelhamville plant	$ 300,000	$ 300,000
Purchase Mamaroneck plant, including 16-inch forcemain	410,000	410,000
Connection to Hill View Reservoir, including booster pump to provide pressure east of Mount Vernon	80,000	160,000
Totals	$ 790,000	$ 870,000
From Mamaroneck River:		
Purchase of Pelhamville plant	$ 300,000	$ 300,000
Purchase of Mamaroneck plant, including 16-inch forcemain	410,000	410,000
Land and reservoirs, on Mamaroneck river	550,102	682,327
Additional pumps and filter equipment.	99,848	175,448
24-inch forcemain to Mount Vernon	252,410	252,410
Totals	$1,612,360	$1,820,185
From Byram River:		
Purchase of Pelhamville plant	$ 300,000	$ 300,000
Purchase of Mamaroneck plant, including 16-inch forcemain	410,000	410,000
Land and reservoirs, on Byram river	397,436	651,666
Pipe lines from Byram river to Mamaroneck	340,000	662,000
Water rights and purchase from present owners	400,000	400,000
Forcemain from Mamaroneck to Mt. Vernon	252,410	252,410
Additions to Mamaroneck pumping station and filters	99,848	175,448
Land and reservoirs at Mamaroneck	100,000	100,000
Totals	$2,299,694	$2,951,524

The investment cost of an adequate water supply from the three sources under discussion varies quite considerably. The smallest cost is, of course, for the supply from New York City. This would be reduced to about $80,000 at the outset if no allowance were made for purchasing the supply works of the New York Inter Urban Water Co. As already stated, we think it is preferable to make such purchase because the city could probably realize from the sale of the Pelhamville and Tom Payne brook properties at an early date, and it is believed that the Mamaroneck pumping station and force main would be

a judicious investment, as the city would have to pay in all probability a substantial sum on account of these holdings if only the pipe system in the city of Mount Vernon were purchased.

A comparison of the investment cost does not constitute a fair comparison of the total cost and relative advantages of the three sources of supply. This is due, of course, to differences in maintenance charges. The fairest way is to make a comparison of the annual fixed capital charges, comprising interest and sinking fund payments, together with the annual cost of operation and maintenance. Adding these several items together, there is obtained a total annual expense of securing a water supply in varying quantities from each of the several sources under comparison. Such comparative estimates of the total cost per annum of the different sources of supply are given in the next table. This table shows, first, the annual fixed charges, which we have placed at 7½ per cent. This is in accordance with our interpretation of Paragraph 12 of Chapter 127 of the Laws of 1911, approved by the Governor on May 10, 1911, creating a Board of Water Supply for the City of Mount Vernon and providing for municipal water works. In this paragraph it is stated that the bonds shall be for a term not exceeding 20 years, and that a sinking fund shall be provided to create an amount equal to the principal of the bonds at their maturity. If payments into a sinking fund should draw interest at 4 per cent., it would be necessary to provide a sinking fund payment of about 3 1/3 per cent. per annum. Adding to this sinking fund payment a reasonable allowance for interest rate, we assume that 7½ per cent. for fixed capital charges is as low a rate as is reasonable, and it may be found necessary to make these charges a little larger.

In the operation of the water supply works, but not including the distribution system, the wages and salaries for employees would be substantially constant regardless of the amount of water sold either to Mount Vernon or to other communities. We have prepared estimates showing a reasonable allowance for such an operating staff as seems to us to be necessary and on the assumption that the operatives would work eight hours per day.

The third item in the following table relates to the estimated cost of fuel, supplies for filtration and other items which would vary in a direct proportion with the amount of water delivered. Estimates for this have been made, based upon reasonable efficiency of pumps and filters, and at present prices for coal, chemicals and minor supplies.

All of these items of annual expense are given for each of the different sources of supply on the basis that such supply per annum would average 3, 4, 5, 6 and 7.5 million gallons daily, respectively. It will be noted that the fixed capital charges increase materially when the daily supply increases above 5 million gallons daily. This is due, of course, to the added investment necessary to increase the capacity of the works from 5 to 7.5 million gallons daily, as shown in the preceding table.

TABLE 7.

Estimated Total Annual Cost of Obtaining a Water Supply for Mount Vernon and Other Communities Supplied by the New York Inter-Urban Water Co. from Different Sources and in Different Quantities.

	Daily Supply, Million Gallons.				
	3.0	4.0	5.0	6.0	7.5
New York City Supply:					
Annual capital charges (7½%)	$ 59,250	$ 59,250	$ 59,250	$ 65,250	$ 65,250
Annual payroll, average repairs and renewals	$ 1,200	1,200	1,200	1,200	1,200
Annual cost of power for booster pump	4,086	5,448	6,811	8,172	9,534
Annual cost of water at $133 per M. G.	145,635	194,180	242,725	291,270	364,087
Totals	$210,171	$260,078	$309,986	$365,892	$440,071
Mamaroneck River Supply:					
Annual capital charges (7½%)	$120,927	$120,927	$120,927	$136,514	$136,514
Annual payroll, average repairs and renewals	17,340	17,940	18,340	18,840	19,340
Annual cost of fuel, coagulant and supplies	9,417	12,556	15,695	18,834	23,542
Totals	$147,684	$151,323	$154,962	$174,188	$179,396
Byram River Supply:					
Annual capital charges (7½%)	$172,475	$172,475	$172,475	$221,364	$221,364
Annual payroll, average repairs and renewals	17,340	17,840	18,340	18,840	19,340
Annual cost of fuel, coagulant and supplies	9,417	12,556	15,695	18,834	23,542
Totals	$199,232	$202,871	$206,510	$259,038	$264,246

In studying the above table, attention is directed to the fact that with the purchase of water from New York City a large portion, from about 65 to about 80 per cent. of the total annual expenses would go to the City of New York for water payments. In the case of a supply obtained from the Mamaroneck river or from Byram river there would be no corresponding water payments to anyone outside of the municipality, although the payments into a sinking fund to retire the bonds at the end of 20 years would be quite substantial. At the end of 20 years, however, in case the supply were obtained from New York City, Mount Vernon would not own the source of supply other than for some connecting pipes and possibly some residue unsold from the present works of the New York Inter Urban Water Co., but would have to continue to pay, according to the present law, $133 per million gallons for all water obtained.

If Mount Vernon should own its own works, however, either on Mamaroneck river or on Byram river, it would pay for such investment, according to the figures above given, in 20 years, because by law the fixed annual charges must be such to retire both principal and interest obligations on the outstanding bonds. In other words, the city of Mount Vernon would have the use of its investment in sources of water supply without added cost beyond the operating expenses at the end of 20 years, which is a much shorter period than the life of reservoirs and the main features of water supply works.

The cost of water per million gallons delivered under pressure into the pipe system of Mount Vernon has become a convenient local yardstick or means of measuring such cost. This is due in part to the price charged by the city of New York, namely, $133 per million gallons. In the following table the estimates of the last preceding table are shown in terms of the total estimated cost per million gallons of obtaining a water supply from the several sources, and when the amount of water ranges from a daily average of 3 millions to a daily average of 7.5 millions. In studying this table it will be noted at once that the supply from New York City is rated at a cost considerably in excess of $133 per million gallons. This is due, of course, to the capital charges for purchasing the existing supply works of the New York Inter Urban Water Co. In a slight measure it is due to operating an electric pump to give adequate pressure east of the city of Mount Vernon. The capital charges of purchasing the existing works belong equally, of course, to the estimated costs of the Mamaroneck and Byram river supplies.

The most striking feature about this table is that it shows the Mamaroneck river supply to be not only reasonable from the point of view of expense, when consideration is given to the difficulty of securing a water supply in Westchester county, but also on account of its being markedly cheaper than a water supply obtained either from New York City or from the Byram river.

It is true that these estimates involve, to a considerable

extent, estimates for the purchase of land and of property, upon which it is difficult to form close figures at this time. We believe, however, that there is no opportunity for differences of opinion as to prices of land and present water supply works of the New York Inter Urban Water Co. to be sufficient to offset or materially to modify the following tabulation of costs, which indicate the Mamaroneck river supply to be decidedly the cheapest source from which Mount Vernon can obtain its future water supply.

TABLE 8.

Estimated Total Cost per Million Gallons of Obtaining a Water Supply for Mount Vernon and Other Communities Supplied by the New York Inter-Urban Water Co. from Different Sources and in Different Quantities.

Daily Supply, Mil. Gals.	N. Y. City Supply.	Mamar'ck River Supply.	Byram River Supply.
3.0	$192	$135	$182
4.0	178	103	138
5.0	170	85	113
6.0	167	79	118
7.5	161	66	97

The data above given have been prepared on the basis of equality as to the several sources of supply in the matter of quantity and pressure. As to quality, we also consider them as substantially equal on the basis of careful patrolling and inspections of the watersheds, such as would preclude gross pollution. Minor pollution, discoloration due to vegetable matter and mud following heavy rains, would be effectively eliminated by a modern filtration plant, carefully built and carefully operated. In fact, a sterilization plant could be operated to supplement the works of a filter plant if desired.

We are aware that the Byram river watershed is now more sparsely populated than is that of Mamaroneck river. This is of some advantage, but we do not know whether in another State the city of Mount Vernon could control the pollution from a growing population as effectively as it could from the Mamaroneck watershed. There is no difference in the quality of water from these two rivers that cannot be overcome uniformly and reliably by means of filtration and sterilization. Hence we do not consider that there is sufficient advantage to Byram river as a source of the future water supply of Mount Vernon to be commensurate with its increased cost. In concluding this subject, therefore, it is our advice that the best step for the City of Mount Vernon to take would be to obtain its future water supply from the Mamaroneck river in conjunction with the existing supply works of the New York Inter Urban Water Co.

PROPOSITION 7.

Distributing Pipe System.

This proposition takes up the preparation of the design for a complete new distributing system within the city limits of Mount Vernon to serve the needs of the city at present and in the early future, and an estimate of the cost of the same. We have conceived this on broad lines of having pipes of sufficient size to provide satisfactory water pressure for domestic use and to give good fire service from a modern standpoint. In fact, it has been our purpose in the new design to eliminate all 4-inch pipe and to make the sizes such that in later years it will be necessary, as the population of the city grows, simply to extend the pipes in streets not now built upon and not to parallel the pipes shown to be required at present.

We have prepared an estimate of the cost of replacing the existing piping system of the New York Inter Urban Water Co. and of such additional pipes as would be needed to reinforcec the existing system to bring it up to the service afforded by the proposed new system.

A comparison is also given of the cost of the proposed new system and of the reinforced existing system, with a view to arriving at the present worth of the existing system, after making due allowance for the depreciation in the existing pipes due to the wear and tear incident to their use during an average life of about 15 years.

In accordance with your instructions and for the sake of recording with completeness the present property of the New York Inter Urban Water Co., we have also included a summary of the piping system used for purposes of distribution by this water company in communities outside of the City of Mount Vernon.

In the following tables a concise statement is given of our findings on the questions above stated, and upon the accompanying maps will be found on sheets Nos. 4, 5 and 6, the location and size of the water pipes owned by the New York Inter Urban Water Co. outside of Mount Vernon. Sheet No. 3 shows the design which we have prepared for the proposed new system of distributing pipes in Mount Vernon. In preparing these estimates of cost we have taken current market prices for labor and materials. We have availed ourselves of all the local information that we could secure through the aid of the city officials in the matter of rock excavation and underground obstructions which would be encountered in the streets of Mount Vernon under the conditions now existing. We have also secured from official records, and checked up the same on the ground, the kind and extent of paving and road surfacing in general which would have to be disturbed in constructing new pipe lines. All of these estimates of cost have been discussed with you and are on file in detail in our office for future reference. We have not considered it expedient, however, to give them in full detail at this

time, prior to the determination by the city of the procedure they propose to adopt in supplying the citizens of Mount Vernon with an adequate and satisfactory water supply for future needs.

One other point is to be recorded at the outset of this report on the pipe proposition, and that is that it is assumed that the future water supply for Mount Vernon will come from the east of the city and enter along the route of the force main of the Pelhamville pumping station. In other words, the pipes are largest in the eastern limits of the city and taper downward progressively towards the western limits. Should a supply be taken from New York City, the relative dimensions of the pipe from east to west would, of course, be reversed.

Proposed New Distribution System.

On sheet No. 3 is shown a design that we have prepared for a new system of distributing pipes to serve the needs of the city at present and in the early future, as above stated. This system of pipes aggregates about 64 miles in length, which is substantially the same in extent as that of the present pipe system of the water company. This proposed system would contain about two miles of pipes as large or larger than the present 16-inch forcemain of the Pelhamville station. No 4-inch pipe would be used, as the smallest diameter is six inches. The system would be well cross-connected, so as to eliminate so far as practicable the present difficulties from low pressure due to the friction losses through long lines of small pipe. As will be noted from Sheet No. 3, comparatively large lines of pipe are interspersed in such a manner as to reduce to reasonable limits the length of flow of water through small pipes on its way to the various consumers. Fire service has especially been kept in mind in providing for the new design, and hydrants have been provided, spaced about 300 feet apart in the business district and about 500 feet apart in the residential district, as with the present pipes.

In addition to the ordinary domestic service we have assumed that in the business district the pipe system should provide for at least 15 fire streams at any one point, and in the residential district 10 fire streams at any one point.

We consider fire provisions are adequately met by the pipe sizes shown, although it is true that a somewhat higher pressure should be uniformly maintained than has recently existed, particularly at times of fires. We have assumed that at no time should the pressure become appreciably less than that corresponding to the full height of water in the existing stand pipe. In fact, it would be preferable to increase this pressure somewhat, in order to give satisfactory service at all times in the residential district. In the business district, in the vicinity of the railroad station the static head would be about 50 pounds, and this would decrease on the higher ground in the vicinity of North Tenth street to a minimum static head of about 35

pounds. At times of fire in the higher district we have assumed, of course, that adequate steamer service would be provided.

Table 9 shows the length of each size of pipe which is proposed for the new distributing system, according to the plan shown on Sheet No. 3. The table also shows the number of valves which would be placed on each size of pipe. The appurtenances of the proposed new pipe system would be substantially the same as in the present system as to number of meters, hydrants and service connections.

TABLE 9.

Length and Size of Pipes and Numbers and Sizes of Valves For the Proposed New Distribution System.

Size.	Pipe Length in Feet.	Number of Gate Valves.
6-inch	212,040	1,034
8-inch	79,000	115
10-inch	32,500	31
12-inch	5,450	8
16-inch	4,320	2
24-inch	2,540	1
30-inch	3,400	1
Totals	339,250	1,192

We have estimated that at current prices of labor and materials this new system of distributing pipes could be put in place with hydrants, meters, service connections, repairs to paving, supervision, inspection and contingencies for the sum of $717,898. It should be added that this figure does not provide for building complete new service pipes, which are now owned by the consumers. But it does provide for disconnecting the existing service pipes from the old pipes and for a reconnecting of them to the new street mains.

The Present Piping System of Mount Vernon.

A substantial outline has already been given in the early pages of this report of the pipe system which gradually has been built during a period of nearly 30 years, although the average life of the system as a whole is barely 15 years. As pipe systems go in communities that grow rapidly, this pipe system compares quite favorably with those found elsewhere as to its general arrangement. Notwithstanding this, the present pipe system has quite marked faults now, due to the installation until quite recently of 4-inch pipe lines in residential districts, particularly where there were but few connections with larger pipes. In the busness district, also, the pipe sizes are small, as viewed in the light of the

requirements which the present density of population demands from the water system, both for domestic service and fire service.

Table 10 shows the length of pipe of each size in the present system and also the number of valves of each size. The number of hydrants now in use is 633 and this number is considered sufficient for the proposed new system. Attention is also called to the fact that the valves on the existing pipe system aggregate only 797, or 395 less than those shown in the design for the new system. The number of service connections, 5,419, and the number of meters, 4,735, correspond to those now in existence and aggregate the same as shown for the proposed new system.

TABLE 10.

Length and Size of Pipe and Number and Size of Valves of Existing Distribution System.

Size.	Pipe Length in Feet.	Number of Gate Valves.
4-inch	52,980	220
6-inch	204,421	481
8-inch	17,048	23
10-inch	38,121	62
12-inch	2,439	7
16-inch	7,090	4
	322,099	797

We have prepared estimates of cost at the same unit prices for labor and materials for building the existing pipe system as we used in obtaining the figures in Table 9 for the proposed new system. In this manner we have obtained the sum of $593,578 as the replacement cost of the present pipe system in Mount Vernon.

Depreciation of Existing Pipe System.

We have figured the depreciation of the existing piping system due to its wear and tear by use to be $37,933. The principal item is, of course, the depreciation of the street mains which now have an average life of about 15 years and which are assumed to be capable of giving reasonable service, so far as depreciation of metal is concerned, for 100 years. This does not make any allowance for the destruction of the pipe by electrolysis. Neither does it make any allowance for depreciation due to the pipe system becoming inadequate in size or unsuitable for the service demanded of it. That question is taken up under the head of "Functional Depreciation." We have taken the average useful life of gate valves and hydrants to be 60 years, and of meters 35 years.

Reinforcing Pipes.

Your instructions provide that we shall prepare an estimate of the cost of laying additional pipes to reinforce the existing pipe system so as to bring it up to the service afforded by the proposed new system. We have given this matter careful study and find that it will take nearly 20 miles. Nearly two miles of these reinforcing pipes would be 16 inches in diameter or greater, constituting the main feeders. All dead ends in the existing pipes would be eliminated and 6-inch pipes placed on all streets now provided with 4-inch pipes. Intermediate sizes of pipe would be used for cross-connecting with the main feeders those streets to be provided with parallel lines of new 6-inch and old 4-inch pipes.

Table 11 shows the length of pipe of each size and the number of gate valves of each size which would be used on these reinforcing pipe lines.

TABLE 11.

Length and Size of Pipe and Number and Size of Valves on Reinforcing Pipe Lines.

Size.	Pipe Length in Feet.	Number of Gate Valves.
6-inch	55,200	615
8-inch	25,400	45
10-inch	13,330	15
12-inch	1,950	4
16-inch	4,000	5
20-inch	2,250	1
24-inch	3,450	3
	105,580	688

At the same unit prices for labor and materials as used in making the estimates for the proposed new system and for the replacement of the existing system we estimate that these reinforcing pipes would cost, complete, about $199,924. This sum includes rock excavation, repairs to street surfaces, an allowance for disconnecting about 1,500 of the existing service connections and reconnecting them to the new pipes, and replacing the present 4-inch hydrants, valves and connections with 6-inch hydrants.

Functional Depreciation of Present Piping System.

This item deals with a comparison of the reinforced present piping system with the proposed new system, with a view to ascertaining what the value is of the present pipe system as it stands, measured by the saving which it would allow in the construction of a modern up-to-date distribution system. As the expression implies, it deals with the lessened value of the present

pipe system, due to the small size of pipe and the fact that considerable expenditure is necessary sooner or later in order to bring the present system up to the standard of service that would be afforded by a new system.

By adding together the present replacement cost of the existing pipe system and the estimated cost of new reinforcing pipes, there is obtained the sum of $793,502. By subtracting from this sum the estimated cost of building the proposed new system there is obtained a difference of $75,604. This sum could scarcely be construed as the reduced value of the present pipe system on account of its small size for several reasons. In the first place, it would provide in the residential districts one 6-inch and one 4-inch pipe on streets where the new system would have only a 6-inch pipe. These duplicate mains may not have greater value as compared with a new 6-inch line, from the standpoint of adding revenue to the water works property, but nevertheless they possess potential advantages which are entitled to consideration. In some cities the conditions are such that duplicate pipe would save the scraping of pipes to clean out deposits of rust or tubercles. While we have not yet had opportunity to examine carefully the interior condition of these pipes, we believe from our general experience with the surface water in this section of the country that pipe cleaning is not necessary with a filtered surface water supply, such as Mount Vernon now receives and where pipes are well flushed to remove accumulations entering the pipes in earlier years.

Another item for our consideration is that the reinforceing need not be done in its entirety within the next few years, although perhaps half of the cost for reinforcing pipes should be expended promptly. The remainder may be added piecemeal as the population grows. In this way a considerable item of saving in the interest on the investment would accrue to the benefit of the reinforced present pipe system, as compared with the proposed new system.

In operating expenses it would be a simpler matter to continue with the present piping system than it would to operate the water works during a period of change from the existing pipes to the proposed new pipes. This saving relates not only to labor expended in the maintenance of the pipe system, but also to operating expenses at the pumping station with respect to the income during days when there would be but few customers to be supplied from the new system.

Another feature of importance is the inconvenience to the community and the individual water consumers incident to the changing of the house service connections, digging up the streets, interruptions in water service, and disturbances to the flow of water through the mains.

Taking into account all of these several items accruing to the credit of the existing piping system as compared with the proposed new piping system, we place the functional depreciation of the present piping system at $50,000.

Present Value of the Existing Piping System.

From the foregoing data it appears from our estimates that the replacement cost of the existing piping system would be $593,578. We deduct from this the estimated depreciation of the present piping system due to wear and tear, $37,933, and also our estimate of the functional depreciation due to the small size of the present piping system, of $50,000. The remaining sum of $505,645 is our finding as to the present value of the piping system of the New York Inter Urban Water Co. within the city limits of Mount Vernon.

Outside Piping.

The estimate above given for the piping owned by the New York Inter Urban Water Co. does not include the force main from the Mamaroneck station to the Pelhamville pumping station, as that is included in the value of the Mamaroneck system.

No value is here placed upon the 16-inch pipe line of the New York Inter Urban Water Co. leading to the Metz reservoir beyond the city limits of Mount Vernon, as it would be of no service to the City of Mount Vernon. There is no doubt, however, that this portion of this pipe line as shown on Sheet No. 2 of the accompanying maps, must have cost at least $75,000. What its salvage might be from the sale to the Consolidated Water Co. of Suburban, N. Y., or to others is a question on which we are not advised.

We have made a careful examination as to the extent of the distributing pipes in other communities around Mount Vernon which are owned by the New York Inter Urban Water Co. and used by them in furnishing hydrant service and water to the residents of Rye, Mamaroneck, Harrison, Pelham, etc. We find that the water company has no contracts with these communities except with the village of Rye, with which a contract was made on July 29, 1909, for hydrant service for a period of five years, and an option for ten years at the stated rates.

The following table shows the length of each size of pipe in the different communities, and the number of meters, gate valves and hydrants. This table also shows the estimated cost of replacing each of these piping systems with repairs and replacements of the brick, asphalt, and macadam pavements over the pipes, as well as the estimated present value of these structures after making deductions for the estimated depreciation. At the bottom of Table 12 will be found a sum representing our estimate of the total value of all of these outside pipe lines, with appurtenances, but exclusive of the 16-inch line to the Metz reservoir, on which comment is made above.

TABLE 12.

Schedule of Piping of New York Inter Urban Water Co. Outside of Mount Vernon, with Estimate of Replacement Cost and Present Value.

Town of Mamaroneck:

	Cost.	Depreciation.	Present Val.
125 ft. 4-in. pipe 19,621 ft. 6-in. pipe 578 ft. 10-in. pipe	$16,338.16	$676.40	$15,661.76
14 4-in. valves 47 6-in. valves 1 10-in. valve	974.46	111.09	863.37
14 4-in. hydrants 13 6-in. hydrants	929.50	105.96	823.54
Macadam paving	4,032.64	0.	4,032.64
Rock	8,295.95	0.	8,295.95
			$29,677.26

Village of Mamaroneck:

	Cost.	Depreciation.	Present Val.
7,590 ft. 3-in. pipe 2,123 ft. 4-in. pipe 1,600 ft. 5-in. pipe 74,851 ft. 6-in. pipe 2,746 ft. 8-in. pipe 7,061 ft. 10-in. pipe 4,650 ft. 12-in. pipe	$85,811.15	$2,201.20	$83,609.95
7 3-in. valves 47 4-in. valves 1 5-in. valve 189 6-in. valves 6 8-in. valves 9 10-in. valves 2 12-in. valves	4,274.83	206.13	4,068.70
54 4-in. hydrants 64 6-in. hydrants	4,138.90	154.22	3,984.68
Macadam paving	20,956.57	0.	20,956.57
Brick paving	4,371.61	0.	4,371.61
Rock paving	40,945.82	0.	40,945.82
			$157,937.33

Village of Rye:

	Cost.	Depreciation.	Present Val.
47 ft. 4-in. pipe 9,148 ft. 6-in. pipe 21,540 ft. 8-in. pipe 4,635 ft. 10-in. pipe 3,510 ft. 12-in. pipe	$41,858.64	$143.42	$41,715.22
6 4-in. valves 76 6-in. valves 16 8-in. valves 5 10-in. valves 2 12-in. valves	1,941.05	14.16	1,926.89
5 4-in. hydrants 67 6-in. hydrants	2,913.55	21.18	2,892.37
Macadam paving	9,344.34	0.	9,344.34
Tar Paving	2,066.39	0.	2,066.39
Rock	20,518.16	0.	20,518.16
			$78,463.37

Town of Rye:

	Cost.	Depreciation.	Present Val.
74 ft. 4-in. pipe 5,875 ft. 6-in. pipe	$ 4,679.19	$ 69.13	$ 4,610.06
2 6-in. valves 6 4-in. valves	102.60	3.83	98.77
6 4-in. hydrants	167.70	6.70	161.00
Macadam paving	1,419.28	0.	1,419.28
Rock	2,803.83	0.	2,803.83
			$9,092.94

Town of Harrison:

	Cost.	Depreciation.	Present Val.
850 ft. 3-in. pipe 190 ft. 3.5-in. pipe 1,875 ft. 4-in. pipe 28,648 ft. 6-in. pipe 5,078 ft. 8-in. pipe 3,700 ft. 10-in. pipe 4,855 ft. 12-in. pipe	$42,908.05	$713.21	$42,194.84
12 4-in. valves 88 6-in. valves 5 8-in. valves 4 10-in. valves 3 12-in. valves	1,963.20	66.36	1,896.84
8 4-in. hydrants 39 6-in. hydrants	1,852.60	60.22	1,792.38
Macadam pavement	9,615.90	0.	9,615.90
Brick pavement	4,183.24	0.	4,183.24
Rock	20,687.10	0.	20,687.10
			$80,370.30

Town of East Chester:

	Cost.	Depreciation.	Present Val.
2,425 ft. 6-in. pipe ...	$ 1,913.33	$ 13.58	$ 1,899.75
7 6-in. valves	116,34	2.21	114.13
Macadam paving	759.06	0.	759.06
Rock	5,659.68	0.	5,659.68
			$8,432.62

Town of Scarsdale:

	Cost.	Depreciation.	Present Val.
567 ft. 6-in. pipe, 1,347 ft. 10-in. pipe	$ 2,272.55	$ 4.20	$ 2,268.35
1 6-in. valve, 1 10-in. valve	48.25	0.29	47.96
Macadam paving	499.92	0.	499.92
Rock	736.32	0.	736.32
			$3,552.55

City of New Rochelle:

	Cost.	Depreciation.	Present Val.
2 6-in. valves, 1 8-in. valve, 1 12-in. valve	$ 96.26	$ 7.71	$ 88.55

Village of Pelham (Pelham Heights):

	Cost.	Depreciation.	Present Val.
18,335 ft. 4-in. pipe, 8,147 ft. 6-in. pipe, 2,400 ft. 10-in. pipe	$20,534.30	$547.74	$19,986.56
28 4-in. valves, 12 6-in. valves, 3 10-in. valves	617.90	106.20	511.70
25 4-in. hydrants	698.75	51.25	638.50
Macadam paving	6,681.12	0.	6,681.12
Rock	5,927.06	0.	5,927.06
			$33,744.94

Village of Pelham Manor:

	Cost.	Depreciation.	Present Val.
1,547 ft. 6-in. pipe....	$ 1,220.58	$ 11.72	$ 1,208.86
1 6-in. valve	16.62	0.43	16.19
Macadam paving	369.40	0.	369.40
Rock	524.37	0.	524.37
			$2,118.82

Village of North Pelham:

	Cost.	Depreciation.	Present Val.
5 6-in. valves	$ 83.10	$ 2.15	$ 80.95

Present Value of Suburban Pipe Systems.

Municipality.	Present Value.
Mamaroneck (Town)	$ 29,677
Mamaroneck (Village)	157,937
Rye (Village)	78,463
Rye (Town)	9,093
Harrison (Town)	80,370
East Chester (Town)	8,433
Scarsdale (Town)	3,553
New Rochelle (City)	89
Pelham (Village)	33,745
Pelham Manor (Village)	2,119
North Pelham (Village)	81
Total	$403,560

SUMMARY AND CONCLUSIONS.

Our findings and conclusions as to providing the City of Mount Vernon with a water supply suitable in quality and adequate in quantity and pressure for the next 25 or 30 years may be briefly summed up as follows:

1. The City of Mount Vernon now uses on an average about 2.5 million gallons of water daily, and should make provision at as early a date as practicable, in view of the recent water shortages, for a supply of about 5 million gallons daily, capable of ultimate development to at least 7.5 million gallons daily.

2. The contract between the City of Mount Vernon and the New York Inter Urban Water Co. having expired, we see no likelihood of the City of Mount Vernon being able to renew that contract under terms which would be advantageous to itself, and which at the same time would enable the present water company to take prompt and adequate steps to prevent recurrences of recent water shortages.

3. As a first step towards securing an adequate water supply for the city, we recommend, without qualification, that the City of Mount Vernon acquire title to the property of the New York Inter Urban Water Co. That is to say, we are in favor of the needs of the urgent local water supply problem being provided for by a municipal plant, rather than one privately owned.

4. We are opposed to the proposition of building a new pipe system in the City of Mount Vernon and proceeding to ignore

the present water company, for reasons stated at length under Proposition 4.

5. We recommend that the city, by purchase or condemnation, obtain the entire property of the New York Inter Urban Water Co., on the ground that such portions as are not needed could probably be disposed of to advantage, and that, in our opinion, the total investment, in proportion to the property obtained, would be better by purchasing the entire plant than would be the case if purchase were made of only those portions immediately serviceable to the City of Mount Vernon.

6. During a large portion of the next 25 or 30 years it will be perfectly feasible for Mount Vernon to supply Mamaroneck, Harrison, Rye Neck, Pelham Heights, etc., with water; but if these other communities should grow very rapidly the day will come ultimately when it will be necessary for them to obtain water from sources other than the project herein recommended. That matter can be definitely settled later on, but we are convinced that for a time it would be desirable for the City of Mount Vernon, if the laws permit, to receive the benefit from the income to be derived from the sale of water to these outside communities.

7. We find that the amount of water which may be secured from wells in Hutchinson creek valley is too small to receive serious consideration other than for emergency use.

8. Water could be secured from the Catskill aqueduct of New York City in the autumn of 1913 or later, but before that time New York City has no water to spare. The unit price to be paid the city of New York for water is much in excess of the cost to Mount Vernon of securing its own supply from the works now owned by the New York Inter Urban Water Co., supplemented by storage to the east of Mount Vernon. Furthermore, if water were obtained from New York City, the city of Mount Vernon would have no supply works of its own, whereas the costs shown for a supply from storage reservoirs owned by the city of Mount Vernon include sinking fund charges to retire the bonds in 20 years. After this period the expenses for operation would be the only cost for supply works municipally owned.

9. The Mamaroneck river furnishes the best source for the future water supply of Mount Vernon. This supply is the cheapest and would be adquate in quantity and pressure, with works that are properly constructed and operated. The quality of water, with proper patrolling of the watershed and carefully operated modern filtration works, should be thoroughly satisfactory.

10. Water from Byram river would also be satisfactory in every way, except as to expense. The distance of this Connecticut watershed from Mount Vernon makes its expense far exceed

the advantage which it might possess over the Mamaroneck watershed, due to the population on its watershed now being more sparse.

11. Our findings, as shown by the proceeding estimates in this report as to the value of the physical property of the New York Inter Urban Water Co., are as follows:

Pelhamville property	$300,000
Mamaroneck property	410,000
Mount Vernon pipe system	505,645
Outside pipe system	403,559
Total	$1,619,204

The above figures, in our judgment, represent reasonable allowances for replacement cost, and depreciation on the basis of current market prices for labor and material. They include contractor's profits and allowances for legal expenses, administrative expenses, engineering, inspection, contingencies, etc. They do not allow for "interest during construction." It would take at least two years to build these works, with expeditious management and with favorable progress made by the contractors. Monthly payments on account to the contractors would have to be made, and it is reasonable to assume that such interest charges as are allowed by the courts in water works valuations would aggregate about one year's interest on the entire cost, as above estimated. This interest allowance should be added to the sum above given.

12. The New York Inter Urban Water Co. has no franchise of value. But it has a built-up business which is entitled to consideration, acording to the decisions of the courts during the past dozen years. This cost of reproducing the established business of a concern is spoken of as "going value," and is comparable in some ways to the "good will" of a mercantile establishment. It is predicated on the assumption (allowed by the courts) that a mere physical plant upon its completion is not equal in value to a plant with its business established. The reason of this is that on the reproductive theory there would be losses of net income to the new or reproduced plant as compared with the income of the works already established during the period necessary for a new plant to build up its business to the level of the existing plant. We have given considerable thought to the question of going value as applied to the property of the New York Inter Urban Water Co. It is not necessary here to give details of the proposition, which has a number of uncertainties as to its scope and size. It is sufficient to say that courts and appraisal boards usually make an allowance for going value of from 10 to 20 per cent. of the physical value of the property. The local water works property is not, in our opinion, one to have an unusually high

going value assigned to it, for a number of reasons. Among them may be mentioned the fact that it is difficult for citizens to get water from wells in this district, and consumers may be reasonably expected to avail themselves of an opportunity to connect with a new water works plant with a greater degree of promptness than would be the case in many places elsewhere. For this and other reasons the period necessary for reproducing the present volume of business would be shorter than in many cases elsewhere, with the result that a reasonable estimate for "going value" would, in our opinion, be below rather than above the average, as found for water plants elsewhere, when expressed with reference to the size of the plant and volume of business. To the items above tabulated it would be necessary to add both the interest during construction and the "going value."

13. On the basis of acquiring the present property of the New York Inter Urban Water Co., as a first step towards securing an ample and satisfactory future water supply to the city, it would, of course, be necessary to provide further funds for the development of water by storage on the Mamaroneck River, as recommended. It will be noted that the development of a 5-million gallon supply equal to about double the present consumption, as shown by the summary of Table 6, provides for an investment in the new water supply works of about $902,360. To this should also be added the sum of $100,000, for necessary improvements to the pipe system in Mount Vernon at an early date. From the aggregate of these sums there could be deducted the proceeds from the sale of real estate of the Pelhamville plant and the reservoirs on Tom Payne Brook. If desired, there could be eliminated the item of $403,559, which is the estimated cost of purchasing the present piping system of the New York Inter Urban Water Co. outside of the city of Mount Vernon. This item involves a study of the net income which could be obtained from these outside communities, if Mount Vernon should decide to purchase the outside piping.

In conclusion we may say that these costs, while in excess of the investments required for some communities of the size of Mount Vernon with its surrounding towns, seem to us to be reasonable, under the existing local conditions. We have not studied in detail all of the expenses in distributing the water to the consumers (maintenance of distributing pipes and meters, accounting and collection of bills) nor the income to be expected, but we have looked into the matter sufficiently to indicate that a good reliable water supply may be obtained with a reasonable schedule of "water rents." In any event, we see no means of proceeding so advantageously in securing proper water service for the city of Mount Vernon as by carrying out the recommendations herein made.

Very truly yours,

GEORGE W. FULLER.

N

TARRYTOWN

HUDSON RIVER

YONKERS

BRYN MAWR SIPTON

YONKERS SIPHON

HILL VIEW RESERVOIR

WESTCHESTER CO.

NEW YORK CITY

MOUNT VERNON

HUTCHINSON

PELHAMVILLE RESERVOIR

NEW ROCHELLE

LOCATION FOR
PROPOSED RESERVOIR - 270,000,000 GAL'S CAP.
ELEV. SPILLWAY 265.0

ELMSFORD SIPHON

ELMSFORD TUNNEL

ELMSFORD TUNNEL SOUTH

ARDSLEY

CATSKILL AQUEDUCT

PLATT AVE. SIPHON

FORT HILL SIPHON

WHITE PLAINS

MAMARONECK RES.
PUMPING STA. & FILTERS

TOM PAINE CREEK

SILVERBRUK

LESTER RESERVOIR

MAHLSTEDT RESERVOIR

N.Y. N.H. & H. R.R.

MAMARONECK

MAMARONECK RIVER

BUND CREEK

LOCATION FOR
PROPOSED RESERVOIR - 1,000,000,000 GAL'S C
ELEV SPILLWAY 125.0

PROPOSED
24" PIPE LINE

PROPOSED
24" PIPE LINE

BYRAM RIVER

NEW YORK
CONNECTICUT

EAST BRANCH

MIDDLE BRANCH

WEST BRANCH

LOCATION FOR
PROPOSED RESERVOIR - 2,100,000,000 GAL'S CAPACITY
ELEV SPILLWAY 230.0

PORT CHESTER

LONG ISLAND SOUND

CITY OF Mt VERNON-N.Y.
BOARD OF WATER SUPPLY
LOCATION MAP
SHOWING TOWNS AND
AVAILABLE SOURCES OF WATER SUPPLY
JULY-1911

George W. Fuller
Engineer

SCALE

SHEET No 1.

Note. Map prepared from information furnished by Water Co. and checked by Engineer.

CITY OF MT VERNON-N.Y.
BOARD OF WATER SUPPLY
MAP SHOWING LOCATION AND SIZE OF PIPE IN PRESENT DISTRIBUTING SYSTEM IN MT VERNON
JULY – 1911

Geo. W. Fuller
Engineer

SCALE — 1000' 2000' 3000'

SHEET No 2.

CITY OF Mt VERNON-N.Y.
BOARD OF WATER SUPPLY
MAP SHOWING LOCATION AND
SIZE OF PIPE IN PROPOSED
NEW DISTRIBUTING SYSTEM IN Mt VERNON
JULY — 1911

George W. Fuller
Engineer

— SCALE —
1000' 0 1000' 2000'

SHEET N° 3.

MOUNT VERNON

EAST CHESTER

PELHAM RESERVOIR
CAPACITY 11,000,000 GALS
Elev. top of dam = 31'

LESTER RESERVOIR
CAPACITY 5,000,000 GALS.
Elev = 91'

MAHLSTEDT RESERVOIR
CAPACITY 65,000,000 GALS.
Elev. top of dam = 80'

HUTCHINSON RIVER

RIVER AVE

FIRST AVE

SIXTH ST

FIFTH AVE

WOLFS LANE

SPARKS AVE

NYAC AVE

CORLISS AVE

PELHAMADE AVE

HIGHBROOK AVE

CLIFF AVE

LORING AVE.

MONTEREY AVE.

CORONA AVE

EIDERWOOD AVE.

COLONIAL AVE.

BOULEVARD

PELHAM ST.

FIRST ST.

N. Y. N. H. & H. R. R.

Note: Map prepared from information furnished by Water Co. and checked by Engineer.

CITY OF MT VERNON-N.Y.
BOARD OF WATER SUPPLY
MAP SHOWING LOCATION AND SIZE
OF WATER PIPES OWNED BY
N.Y. INTER URBAN WATER CO.
IN PELHAM
JULY – 1911

George W. Fuller
Engineer

— SCALE —

SHEET Nº 4.

Note- Map prepared from information furnished by Water Co. and checked by Engineer.

CITY OF MT VERNON-N.Y.
BOARD OF WATER SUPPLY
MAP SHOWING LOCATION AND SIZE
OF WATER PIPES OWNED BY
N.Y. INTER URBAN WATER CO.
IN HARRISON
JULY - 1911

George W. Fuller
Engineer

SCALE

SHEET No 8.

MAMARONECK RESERVOIR
CAPACITY 12,000,000 GALS

MAMARONECK
PUMPING STATION

OLD DISTRIBUTING
RESERVOIR

MAMARONECK
RIVER

MAMARONECK

RYE NECK

N. Y. N. H. & H. R. R.

WALNUT AVE

MYRTLE AVE

LAUREL AVE

PALMER AVE

HOWELL AVE

WEAVER ST

BOSTON POST ROAD

HOYT AVE

MAPLE AVE

PLEASANT AVE

MAMARONECK AVE

DELANCY

FENIMORE

MT VERNON

ELM ST

MELBOURNE AVE

BEACH AVE

STUART AVE

ORIENTA AVE

MAMARONECK
HARBOR

LARCHMONT
HARBOR

BARRY

LONG ISLAND SOUND

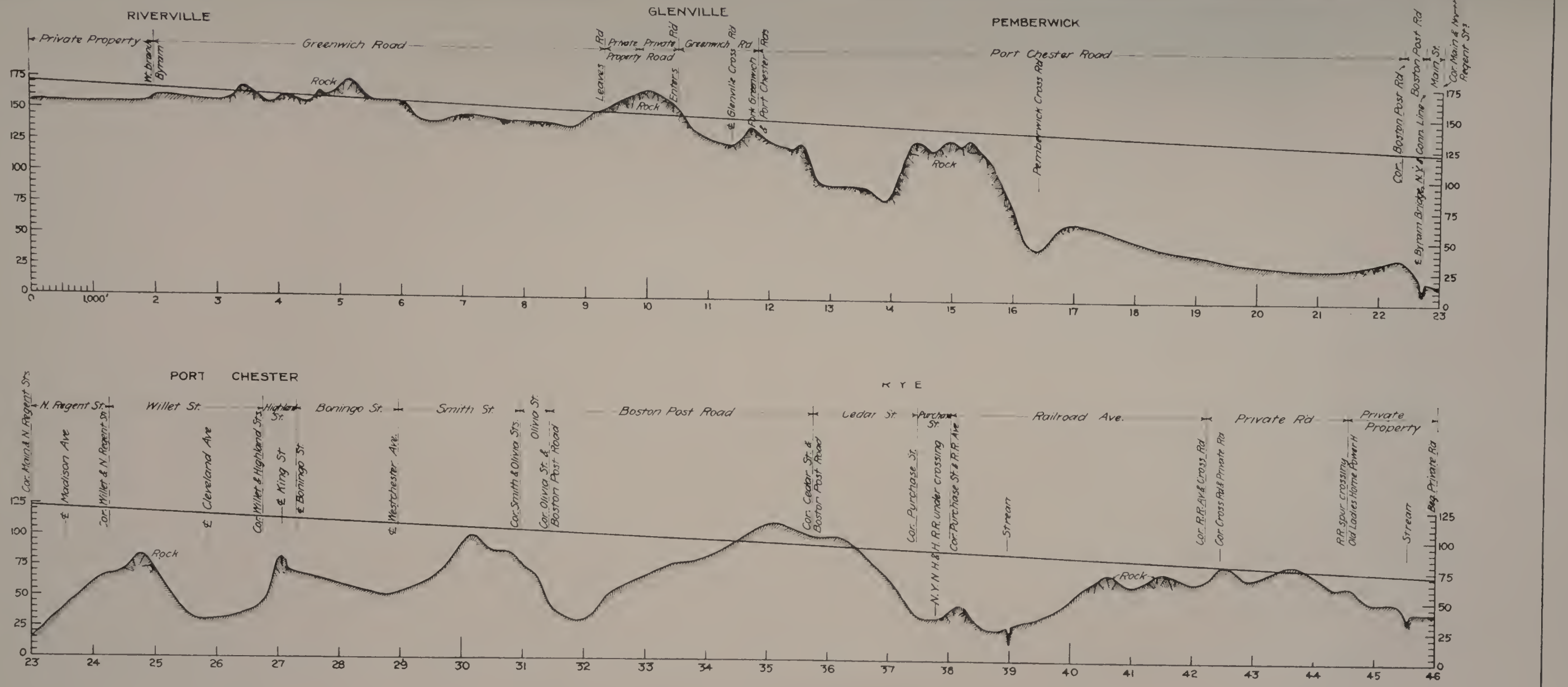
Note. Map prepared from information furnished by Water Co. and checked by Engineer.

CITY OF MT VERNON-N.Y.
BOARD OF WATER SUPPLY
MAP SHOWING LOCATION AND SIZE
OF WATER PIPES OWNED BY
N.Y. INTER URBAN WATER CO.
IN MAMARONECK AND RYE
JULY – 1911

George W. Fuller
Engineer

— SCALE —

SHEET No 6



CITY OF MT. VERNON-N.Y.
BOARD OF WATER SUPPLY
PROFILE FOR PIPE LINE
FROM PROPOSED RESERVOIR
BYRAM RIVER TO MAMARONECK PUMPING STA.
JULY-1911

Engineer

SCALES { HOR. 1" = 1,000'
VERT 1" = 50

SHEET Nº 7.